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POWER

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The Power Engineer's Outlook

THERE has been discussion in *Power* and elsewhere about the discouraging outlook for the power-plant engineer.

There are complaints of low wages, diminishing opportunities, lack of recognition of ability and willingness to exercise it.

Large salaries go to men who can do exceptional things or can do something exceptionally well.

The man who can do only what hundreds of other men available in his vicinity can do has too much competition in an unorganized industry to get more than an ordinary wage.

The opportunities for that kind of a man *are* diminishing. The establishment that has no more of a power department than can be entrusted to untrained, incompetent supervision, the management that has so little regard for efficiency in the various services that a considerable power department is called upon to furnish as to balk at putting a real engineer in charge of it, better be buying its power and is finding it out.

But opportunity was never more open to the real power engineer. The amount of mechanically produced power used is increasing by leaps and bounds. New uses for power develop almost daily. The amount of power-producing apparatus is greater from year to year and somebody must be found who can select, install and manage it effectively.

With higher pressures and temperatures and more complicated apparatus for their production and utilization, with the multiplication of processes requiring heat, refrigeration and pressure, the responsible head of the power plant has more and more opportunities for the exercise of real engineering and the achievement of worth-while results.

The plaint that has the most justification behind it is that of lack of appreciation, but I shall have to make another story of that.

F. R. Low

POWER *Stands for . . .*

1. **Making Power When It Should Be Made**
2. **Buying Power When It Should Be Bought**
3. **Cheaper Power Through Modern Equipment**
4. **Easier Financing of Equipment Purchases**
5. **Better Use of Byproduct Heat and Power**
6. **Operating Methods That Save Money**
7. **Less Waste in Transportation and Application**

Imagine the Savings!

IMAGINE what a difference it would make in the production costs if the process heat, whether from electricity, steam or other source, in some industries could be applied as efficiently as it is generated. Unfortunately, some plants do not realize that heat is being wasted in their process applications. As a result, their costs are higher than need be and their competitive position is hurt.

It is true that the production men in the plant are the men best suited to determine how process heat should be applied, for they know how the product must be made to give the best results. But it is also true that the production men do not have the same solicitude for economical application of heat energy as does the power engineer. The wisest plan in making such applications is for both to co-operate, thereby insuring a satisfactory result in every way.

When the management of plants where heat is wasted in process work realizes how this loss increases production costs, they will see to it that the engineer is always consulted. And when they do this, imagine the savings that will be made!

Industrial Museums Can Render Service

MUCH talk has been heard recently of the necessity for establishing industrial museums in the United States. In fact, so much has been said, that the patient listener tends to tire and lose interest in the matter. This is unfortunate, and it is to be hoped that sufficient interest will survive to make certain the founding of such institutions. They are a needed, though missing, aid to American engineering.

All present-day scientific and engineering practice rests squarely on the foundation of past endeavor. In order that progress and improvement may continue it is not enough to know what exists today. There must also be knowledge of what has gone before.

This is well recognized in educational circles. The text books used by our schools and colleges, or studied by the ambitious in their spare time, are as careful to trace the steps in the development of a science or branch of engineering as to set down the most modern theory.

But this is not enough. The visual aid of actual, historic machines is needed. A short inspection of a series of steam engines, from Newcomen to the modern uniflow, will teach more about how the device developed than hours of reading. And one who sets out to change or improve the engine needs this knowledge to shorten his path and help him avoid mistakes already made by others.

It is to be hoped, therefore, that engineers as a class, and power engineers in particular, will support the museum movement. They cannot fail to profit from its success.

Operating Methods That Save Money

EVERY plant must have its day of reckoning, a time when the accumulated haze of guesswork and indifference is driven out by the cold blast of fact. The waste revealed on such occasions is sometimes astounding in amount and in the variety of its manifestations. Engineers should greet such revelations with mixed emotions: shame that the wastes have continued so long and pleasure at the wonderful opportunity for future saving. Sometimes this possible saving is largely a matter of new equipment. In other cases it hinges more on operating methods, although both are generally involved to some extent.

A case where improved operating methods seemed to offer the chief opportunity is described in the leading article of this issue. An engineering study of the Ingersoll watch plant uncovered many opportunities to save money: Analysis of combustion conditions, together with revamping of the boilers, baffles and other changes, cut steam costs almost in half. Big savings in steam consumption were made by reducing process pressures, providing for multiple-feed heating and changing the power-process hookup generally.

This is a simple example of what the application of a little engineering could accomplish in many other plants.

Atomic Energy— Will It Provide Power?

MEN of far vision, looking forward to the day when resources of fuel become exhausted, have tried to forecast what will then be the source of power upon which man must depend. Most often, these prophets have turned to the energy locked within the atom. It has been confidently predicted that science will find some way to make this available for the generation of power, perhaps long before it is needed.

But now comes Dr. R. A. Millikan, a leading physicist

of the day, saying that this will never come to pass. On Sept. 4, he told the Society of Chemical Industry that he is satisfied that the atoms of the vast majority of elements available on this globe are in such a state of stability that no opportunity offers for deriving power from them. Vast stores of energy are released by the disintegration of atoms in the stars. Dr. Millikan holds that the resulting atomic fragments are combined, in interstellar space, into stable atoms through the agency of radiant energy. He sees no hope for duplicating this cycle upon the earth. Hence he does not believe in the possibility of power from the atom.

Undoubtedly, there will be those who will take the opposite view, perhaps on equally sound grounds. The resulting discussion will be of great interest to all power engineers, and increased knowledge of the true nature of matter and energy will flow therefrom. But there is a pleasant remoteness about such a question that will keep the engineer from becoming unduly worried. Whatever the prospects for atomic power may be, there is fuel enough and to spare in the world for this and many future generations, and the present trend of improved utilization sets the dark day of exhaustion ever further away.

Canada's Progress in Water-Power Development

THE Federal Water Power Act, passed in 1920, preceded an unprecedented period of water-power development. In the fifty years prior to the passage of the Act, about seven-million horsepower was developed in this country. In the eight years since 1919, over four-million horse power have been brought into service. This clearly shows the water-power act to possess elements that will foster power development, if it is allowed to function as intended. Unfortunately, conditions are being created that threaten serious restriction of development. Already the effects are apparent.

While the United States is apparently approaching a stalemate in water-power development, Canada is making rapid progress. This year our neighbor on the North will put into operation over one-half million horsepower. All over that country large projects are actively under way. At the present time seven projects of over one-half million horsepower each are in operation or being actively pushed. What a contrast with the large projects that are tied up in the United States for political or other reasons! Canada, with a population one twelfth of ours has developed about five million horsepower of water power against twelve-million in the United States.

In general the economic conditions in Canada are different from those in the United States. Industrial development in some sections of Canada depends largely upon water power, but even in sections where coal is available, water-power developments are being actively executed. In this country, systems of accounting, special taxes on power produced by water, disagreements between different groups of interests, and political expediency, are making water-power developments unattractive projects, even where they could normally compete with steam plants.

The people of the United States have been credited with progressive business policies and ability for doing things. In water-power development it looks as if we could learn something from our Northern neighbor. She certainly is getting action, while our efforts are wasted by wrangling and political obstruction.

Profits Waiting to Be Picked

A CERTAIN textile mill burns about 6,000 tons of coal yearly to produce steam for process and heating. The same plant purchases 720,000 kilowatt-hours annually. No power is produced locally. Is it possible to justify such a method of operation, even though every allowance is made for special conditions?

It doesn't take much of a pressure drop to produce 400 kilowatt-hours as a byproduct from each ton of coal burned to make process steam. If the processes really require 6,000 tons of coal in this plant it should easily be possible, by choosing proper boiler and process pressures, to generate two and one-half million kilowatt-hours annually. This certainly allows ample margin to cover practically all of the 720,000 actually required, even though power and steam loads do not synchronize.

In a plant of this type the cost of the necessary equipment for the generation of byproduct power, even including new boilers, would be wiped out by the savings in a surprisingly short time. Certainly no plant in the textile industry can afford to overlook such an opportunity for increased profits.

The Seventh Power Show

IF POWER shows lived solely on the idle curiosity of the mechanically minded they could not long survive. Such exhibitions flourish because they fill fundamental economic needs—the manufacturer's need for new customers, and the need of the engineer to know what is available for doing a better job of generating, transmitting and applying the power services.

The engineer who takes his own problems to the exhibition is more likely than not to find solutions ready made. A single idea, or knowledge of a single new piece of equipment, may easily pay for his trip.

The Seventh National Exposition of Power and Mechanical Engineering will be held at the Grand Central Palace, New York, December 3-8, at the time of the annual A.S.M.E. meeting. According to present indications it will surpass even last year's record in number of exhibits and in attendance. This yearly event is a unique opportunity for power engineers. They cannot fail to profit by attendance.

AN ENGINEERING STUDY

of the Ingersoll Watch Plant

By Fred. W. Carter
Plant Engineer

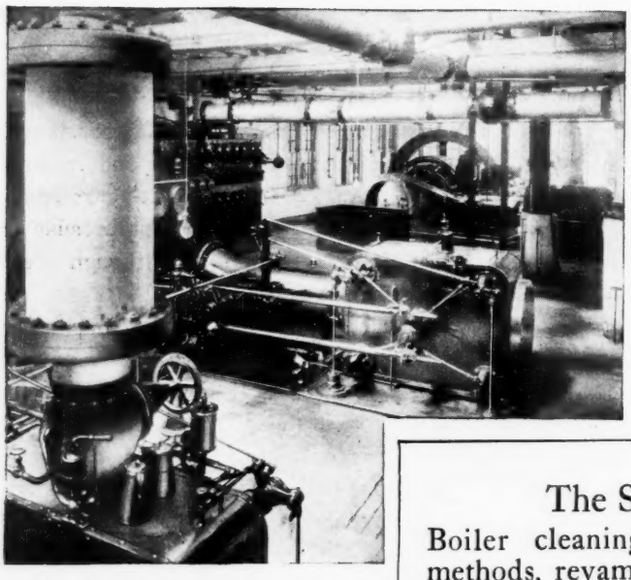


Fig. 1—The Ingersoll engine room

WHEN I came to the plant where the Ingersoll watch is made, in Waterbury, Conn., my first duty was to make a study of the light, heat and power generating department, to determine if the apparatus in use was the best for existing conditions, to test the efficiency of the plant and to find the cost of power services.

The equipment in the boiler house is listed in Table II. There are soot blowers on the two Connelly boilers but none on the Stirling boiler. The allowable boiler pressure was 180 pounds.

Coal is stored in a concrete bunker outside of the boiler house, with a capacity of 2,000 tons.

The power generating plant is listed in Table I, and, as evident, none of the units is of recent date. In addition to the power developed by this equipment, purchased energy to the extent of an average consumption of 150 kw. was used.

Some records had been kept, and while they were not all that might be desired, they formed a basis upon which an intelligent study could be made of past performance.

A preliminary study of the steam generating plant showed an evaporation of 6 lb. of water per pound of coal as fired, using a coal of 13,000 B.t.u. and 2 per cent moisture. The steam pressure carried was under 150 lb. An examination of the boilers showed them to be considerably scaled, and after a careful consideration of our feed-water conditions, source of supply and methods of feed-water treatment, it was decided to turbine the boilers and use soda ash as a scale preventive.

An analysis of the feed water showed as follows: Silica, 0.19; iron and aluminum oxides, 0.12; calcium carbonate, 2.36; calcium sulphate, 0.59; magnesium sulphate, 1.20; sodium sulphate, 0.20; sodium chloride, 1.01; oil, 0.31 per cent.

After the boilers were turbined, a considerable saving in coal was realized, the evaporation being brought up to 8 lb. of water per pound of coal as fired.

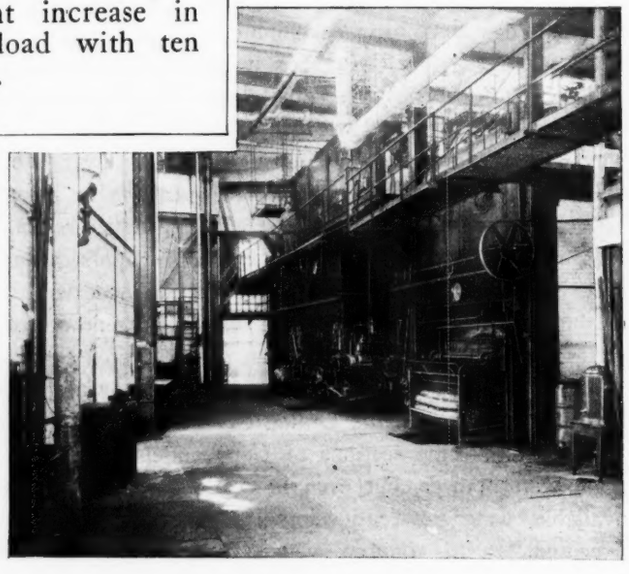
The next step was a study of combustion conditions, methods of firing, operation of the stokers, banking methods and stand-by losses. Through instructions to the firemen on proper firing methods and rearrangement of the banking methods, a still further reduction was obtained in the coal consumption and the evaporation ratio increased to 8.5.

A set of tests was next made of several grades of coal, and it was found that by burning a certain grade with a 14,900-B.t.u. heat content, a reduction in

The Savings

Boiler cleaning, better firing methods, revamped baffling and selection of new fuel raised the evaporation from 6 to 10 lb. of water per pound of coal. At the same time the actual boiler steaming capacity was increased thirty per cent. Lowered process pressures and better use of exhaust for feed heating, building heating and process reduced steam demands. As a result the plant was enabled to carry a twenty per cent increase in manufacturing load with ten per cent less fuel.

Fig. 2—View down boiler room aisle



evaporating costs of three cents per 1,000 lb. of steam was made over the cost when burning the 13,000-B.t.u. coal previously used.

The graph, Fig. 3, shows the steady reduction of the cost to generate 1,000 lb. of steam.

A Bailey boiler meter was installed on one of the Connelly boilers to guide the fireman in the matter of proper combustion. This effected a still further saving in fuel, and another one like it was installed on the other Connelly boiler.

Complete records are carefully kept of the daily performance of the steam generating plant. From these daily readings weekly and monthly operating and cost records are prepared, showing just what is being done and at what cost. These records serve as a guide to keep the plant up to its best efficiency, and this increased efficiency has been brought about without the expenditure of any money on new apparatus, except the amount expended on the two boiler instruments.

As a result of the study of the two Connelly boilers it was decided to baffle the boilers so as to effect a cross-travel of the gases with relation to the tubes, as far as it was possible to do with this type of boiler.

The original baffles gave a flow of gases parallel with the tubes. There were three reasons for making a change in the baffles: A 100 per cent rating was all that could be obtained without fear of losing steam pressure; the temperature of the exit flue gases from the boiler was 225 deg. F. above the saturated steam at 100 per cent rating, and the boiler efficiency was too low.

The results obtained from this change of method of baffling have been very satisfactory. The temperature of the exit flue gases was reduced 125 deg. F., the boiler efficiency was increased 3 per cent and the boiler load was increased to 130 per cent of the rating. The evaporation now averages 10 lb. of water per pound of coal as fired.

The writer's investigations were next turned to the power-generation and steam-consuming part of the plant.

The two cross-compound engines were running condensing, while the Ames single-cylinder engine, used at night and as a light-load unit, ran non-condensing. The Nordberg and the single-cylinder Harris-Corliss were run non-condensing, and the steam from these units was used for heating during the heating months. As this steam was not enough, live steam direct from the boilers was used to make up requirements. All process steam was taken direct from the boilers.

A study was made and tests were run to determine whether or not exhaust steam could be used on process work and at what pressure. It was found that exhaust steam at 2 lb. gage pressure could be successfully used on all process work, the real problem being to have sufficient pipe capacity.

It was decided to run one of the cross-compound units non-condensing, the exhaust to be used for heating and process systems, and to rearrange the load so as to carry it on the cross-compound units. This allowed us to shut down the single-cylinder units. Tests on the single-cylinder units showed 40 lb. of steam per kilowatt-hour and 23 lb. of steam per kilowatt-hour on the cross-compound units.

Under the new operating conditions we have one cross-compound unit running condensing and another cross-compound unit running non-condensing and discharging into the heating and process systems; both generators operate in parallel and deliver current to the main busses at the switchboard.

The load between the two units is adjusted by the rheostats to obtain sufficient exhaust steam to meet the heating and process-steam demands. No steam is wasted to the atmosphere, no steam is wasted to the condenser that can be used for heat or process, and no live steam is used for heating or for process. The conditions are ideal and the arrangement works perfectly.

TABLE I—ENGINE ROOM EQUIPMENT

One Hewes & Phillips 14- and 26x36-in., 125 r.p.m. cross-compound engine direct connected to a Crocker-Wheeler 250-kw. 120-volt d.c. generator.

One Barometric condenser.

One closed-type feed-water heater connected in the line between the low-pressure cylinder and the condenser.

One Hewes & Phillips 14- and 28x36-in., 125 r.p.m. cross-compound engine direct-connected to a Sprague Electric 250-kw. 120-volt d.c. generator.

One barometric condenser.

One closed-type feed-water heater connected in the line between the low-pressure cylinder and the condenser.

One Ames 13x16-in., 250 r.p.m. engine, direct-connected to a 100-kw. G.E. 120-volt d.c. generator.

One 16x36-in. 90 r.p.m. Harris-Corliss non-condensing engine belted to a Western Electric 120-kw. 120-volt d.c. generator.

One 16x36-in. 110 r.p.m. Nordberg non-condensing engine belted to a jack shaft.

The feed-water temperature was next in line for consideration, and a study showed certain changes to be desirable. When these were made, a net increase of 30 deg. F. in water temperature was obtained.

Under the original plan water was passed through the heaters in the exhaust line in parallel, with both engines running condensing. With one of the units running non-condensing, conditions changed so as to make it desirable to pass the water through the heaters in series.

The cold water is first passed through the heater on the condensing unit, raising the temperature to 60 deg. The water is next passed through the heater on the non-condensing unit, raising the temperature to 86 deg., after which the water is discharged into a receiver. Into this receiver are also discharged all the returns from the heating systems, process work and traps, as well as the cold makeup water needed, with a resultant temperature of 150 deg. F. The boiler-feed pump takes the water from this receiver and forces it through the No. 3 heater, again raising the temperature to 210 deg. F. From this heater the feed water is passed through the economizers, the temperature going to 278 deg., and into the boilers. The No. 3 heater is in the exhaust from the Ames engine. When this engine is not running, the exhaust from the cross-compound supplies steam for heating the feed water. By keeping the heater properly drained of condensation, it acts on the induction principle.

This arrangement gives us what we might call four-stage heating, and it has been accomplished at little cost, less than $100 in piping changes.

A complete record of the daily performance of the power plant is kept. From these daily readings weekly and monthly operating and cost reports are prepared, showing just what is being done and at what cost. Cost and operating records covering the purchased power are also kept. From these records we know how the cost of generating our own power compares with the cost of pur-

chased power, a very important thing to know in order to be able to decide certain policies relative to the buying or generating of power.

During eight months of the year all power generated

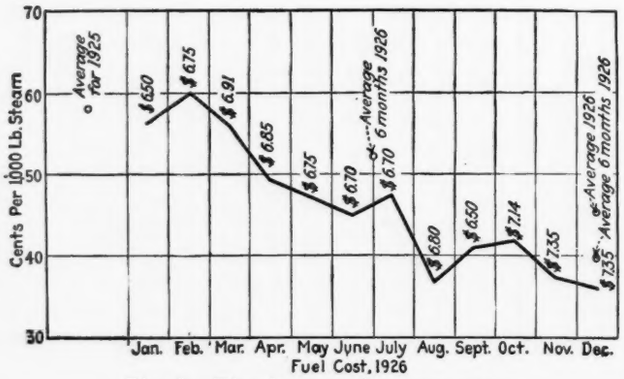


Fig. 3—The decrease in steam costs

is a byproduct, and during the remaining months about 50 per cent of the power is a byproduct.

TABLE I:—BOILER-HOUSE EQUIPMENT

One 2,500-sq.ft. Stirling boiler.
One Keystone chain-grate stoker.
Two 5,400-sq.ft. Connelly boilers.
One Green fuel economizer with 96 tubes, 9 ft. 4 in. long.
Two Detroit natural-draft V-type stokers, 9 ft. 4 in. long.
One Green fuel economizer with 400 tubes.
One American steam-jet ash conveyor.
One 175-ft. brick chimney.
One 14x18-12-in. simplex outside-packed plunger boiler-feed pump.
One close-type feed-water heater.

We are operating at present with an increase of 20 per cent in the load and a decrease of 10 per cent in the

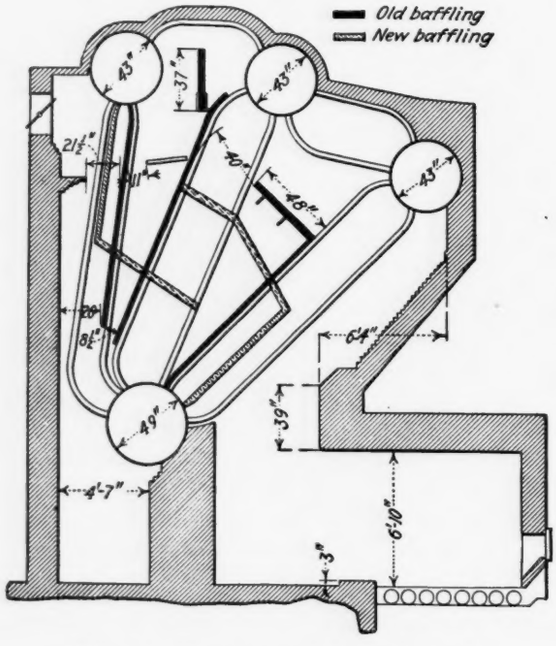


Fig. 4—Alterations made on the boilers

amount of coal burned, representing a marked decrease in the coal bill.

The rearrangements have been made with a comparatively small outlay of money and no changes in the personnel of the plant.

Renewing Stay Bolts in Old Boilers

By R. A. Cultra

It is a common occurrence in most internally fired boilers which have been in service several years to find broken stay bolts in the fire-box sheets at almost every cleaning. The following case is typical.

The boiler in question was thirty-five years old and of the vertical fire-tube type, 6 ft. in diameter and 20 ft. high. There were three boilers in the battery. One was washed out each week and almost as often a new stay bolt had to be put in. This was becoming a serious affair, and it was decided to put in all new stay bolts. Though an expensive job, it stopped this constant breakage.

It is my firm belief that boilers of this age, when stay bolts begin to break so frequently, should have all the stay bolts renewed as a matter of safety. When one bolt breaks it is more or less stretched and the fracture is indicated either by the water coming out through the holes in the ends or by the plate becoming slightly bulged out where a bolt is broken. A tap with a hammer when the boiler is empty is proof enough for any inspector.

The portion of the plate formerly sustained by a bolt that is broken adds that much more stress on the surrounding stay bolts, and the additional strain often causes these others to break. Then too, in some cases where a single stay bolt has been renewed, the old bolts are already stretched. The bolt put in, being new, will stretch some, allowing the surrounding old bolts to sustain more than their allotted share of the load. After a few weeks the new bolt is found to be perfect while the surrounding bolts have broken.

In some cases in past years, boiler makers, when renewing stay bolts, had to cut or drill out the old bolts. This spoils the threads in the plates and made it necessary to replace the old bolts by larger ones.

The present method of taking out the old stay bolts is to use a cutting torch, burning out the centers. The piece is then chipped out and a tap is run through to clean out the thread. Insertion and riveting over of a new stay bolt completes the job. The cost of renewing all the old stay bolts of a boiler in this manner is not as much as might be expected.

When good condition of shells and seams of old boilers allows continued service at high pressure it pays to renew all the stay bolts rather than a few here and there.

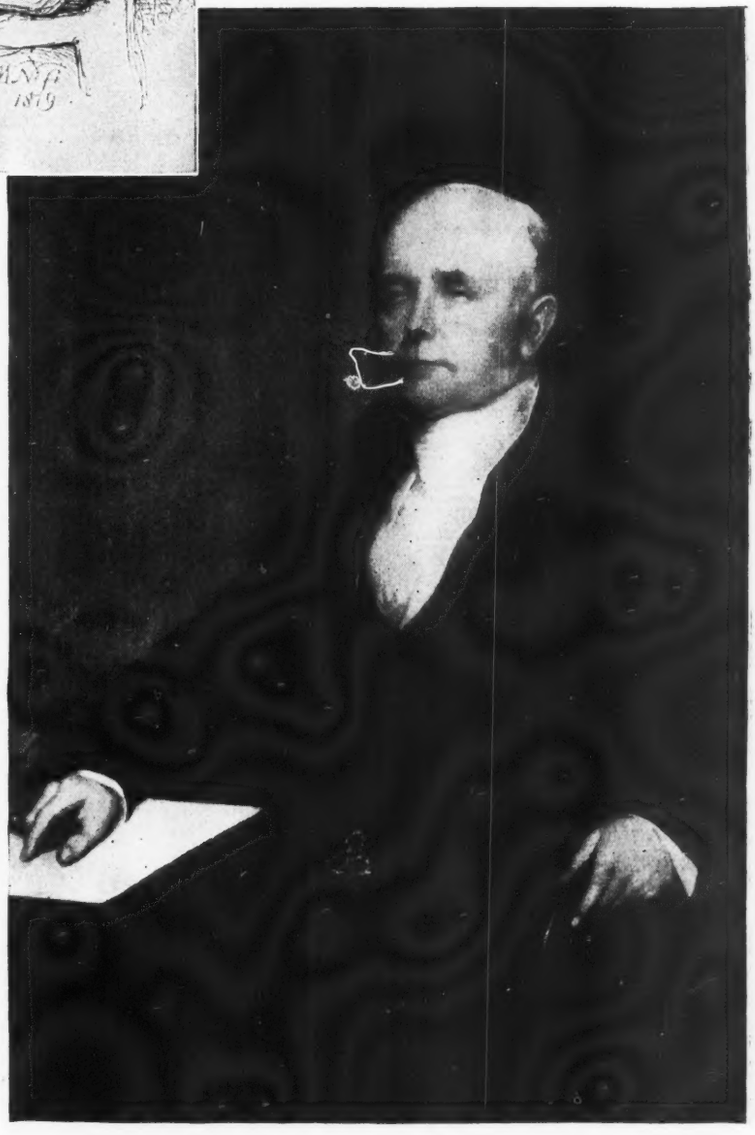
Instruments Save $10,000

By the intelligent use of instruments the Merrimac Chemical Company is saving more than $10,000 yearly. The facts and many interesting suggestions to other plants are contained in an article by W. H. Scott, Chief Engineer, which will appear in the Sept. 25 issue of *Power*.

ENGINEERS WHO WROTE HISTORY

ABOVE—JAMES WATT

As with all engineers who succeed, James Watt was a combination of business man and engineer, with the business man predominating. Born in Greenoch, Scotland, in 1736, chance brought him into contact with a Newcomen engine; this led to Watt's invention of a separate condenser, the double-acting engine and the expansive working of steam. Owing to his business acumen the firm of Boulton & Watt prospered. Much of his later days were spent in fighting steam-engine improvements developed by others. He died in 1819.



RIGHT—JACOB PERKINS

In this day of 1,200-lb. steam pressures, it is well to remember that 100 years ago Jacob Perkins used this high-pressure in his uniflow engine. Perkins was born in Newburyport, Mass., in 1766 and after building minting machinery for Massachusetts, moved to England. There he invented the bank-note stereotype plate, a steam cannon, the uniflow engine, high-pressure boilers and the steam-baking oven. He died in 1849, and although too often ignored, his achievements left their impression upon engineering history.

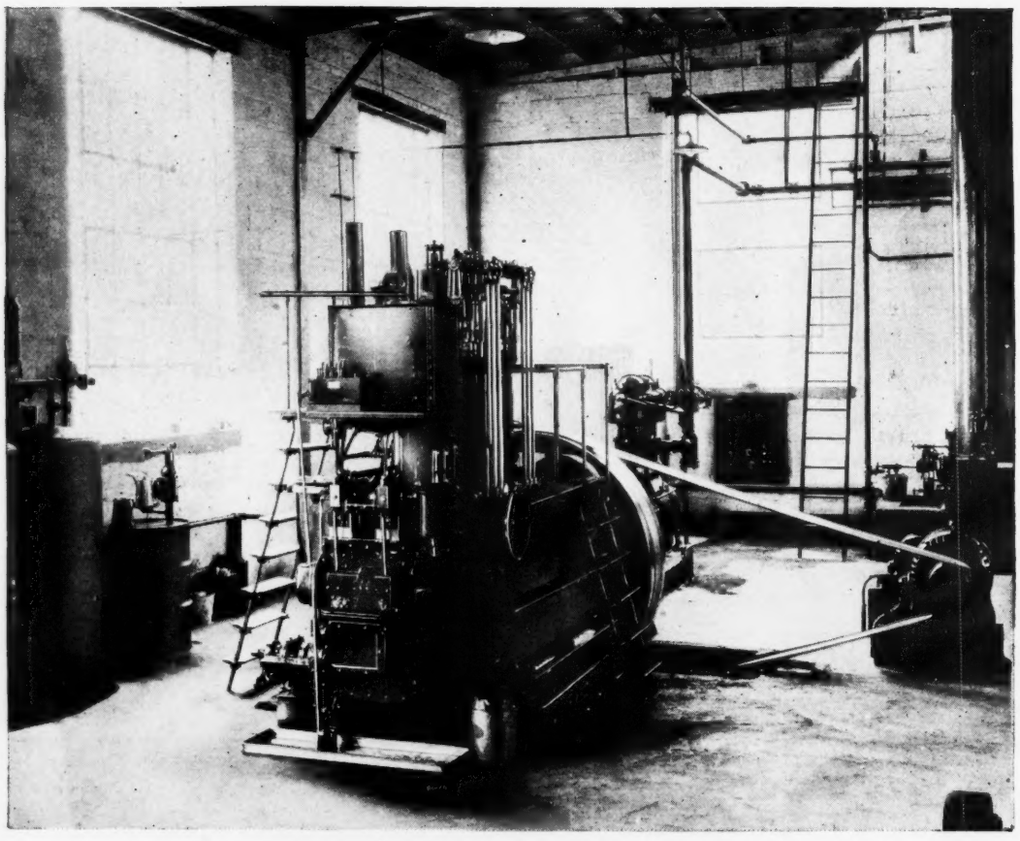


Fig. 1—The Perkasie ice plant

A Dieselized Ice Plant

Meets All Competition

BY G. GROW

THOSE who feel that this is the day of large consolidations and fear that the small ice manufacturer is doomed, will find more than a ray of encouragement in the success of the Diesel-driven Perkasie, Pa., plant of the Lansdale Ice & Storage Company. This 25-ton plant supplies ice to Perkasie and surrounding villages, and, owing to the low cost of manufacture, can sell this ice to the various peddlers at a price below that offered by the large Philadelphia ice factories.

The low cost is not traceable to a failure on the part of the owners to set up the proper overhead charges nor to a small investment per unit of capacity, for the plant is modern in every respect and its initial cost per ton probably exceeds that of a large plant. In designing the plant and choosing the equipment, chief attention was placed on obtaining a cheap source of power and on installing machinery that could be handled with the minimum of labor.

For a small plant steam drive was out of the question, and in this particular section of Pennsylvania electric rates are not very low. After examination of the situation the owners decided to install a four-stroke-cycle Otto-Superior Diesel rated at 100 hp. at 277 r.p.m. This two-cylinder unit operates on the solid-injection principle, with the oil spraying into a combustion chamber formed by the concave top of the piston.

Fuel is stored outside the building in a steel tank, and a service pump, mounted on the engine, delivers it to a small reservoir, from which the injection pump delivers it to the cylinder.

The crankshaft bearings are pressure lubricated, but the cylinders are oiled by the spray formed from the leakage of the crankpin bearings. The used lubricating oil is taken from the crankpit and is first passed through a Nugent filter placed at the end of the engine and above the control gear. From this gravity filter the oil is passed through a Sharples centrifuge mounted alongside. This filter has an inclosed driving motor which is fed from the plant's lighting circuit. It is necessary to open and clean this filter at the end of each shift to remove the dirt and asphaltic residue deposited along the centrifuge vanes. The clean oil, after leaving the filter, is pumped into the circulating pipes.

Air for the engine cylinder is now drawn through vertical pipes from above the roof. This prevents the influx of cold air in winter which takes place if the cylinder air is taken directly from the room, although the latter was the method used at first, as shown in Fig. 1. The exhaust line passes under the floor level into an outside concrete pit having a vertical outlet pipe. To take care of any explosion that might take place in the pit, a spring-loaded manhole cover, or relief plate, is provided in the top of the pit.

The fuel used ranges from 26 to 30 deg. Bé. costing approximately six cents per gallon delivered. The engine uses 4½ gal. per ton of ice made.

The engine is equipped with Moto Meter Co. thermometer on the water lines; usually, the outlet temperature ranges around 120 deg. F., with the intake at 70 deg. A 2-in. Viking centrifugal pump direct-connected to a 1-hp. Robbins & Meyer 1,750-r.p.m. three-phase motor handles the engine cooling water, taking its suction from the condenser sump, but a connection is made to the city water mains to prevent shutdown in case the well gives trouble.

To the engine is connected through a clutch, a twin-cylinder York vertical single-acting compressor, as shown in Fig. 2, and to supply auxiliary power for the pumps, a 20-kw. 1,800-r.p.m. Allis-Chalmers alternating-current generator is driven from the engine flywheel through an Alexander short-center leather belt. The 2-kw. exciter is connected to the generator through a Texrope drive.

To insure starting air at all times, a 6.5-hp. Alamo gasoline engine is belted to a Worthington 4½x5 air compressor. This compressor charges the two air-starting tanks, which are built for 260 lb. pressure, and were supplied by the Airtight Steel Tank Company.

The condenser is a York vertical sheet-and-tube design and is shown at the background in Fig. 2. Cooling water is obtained from a well outside the building and is delivered to the condenser by a pipe passing across the roof. The water, after discharging into the concrete sump below the condenser, wastes into the sewer.

A York float-controlled liquid feed handles the liquid ammonia to the evaporating coils. This device delivers the liquid at a rate to keep the coils filled and requires no manual adjustment. The tank holds three hundred and sixty 300-lb. cans. These cans are pulled in gangs of five, a traveling crane being used. The York can filler, Euclid hoist and a gang of cans are shown in Fig. 5.

The head pressure carried in summer averages 170 lb. gage, while the suction pressure often goes as low as 5 lb. gage to obtain capacity from the tank.

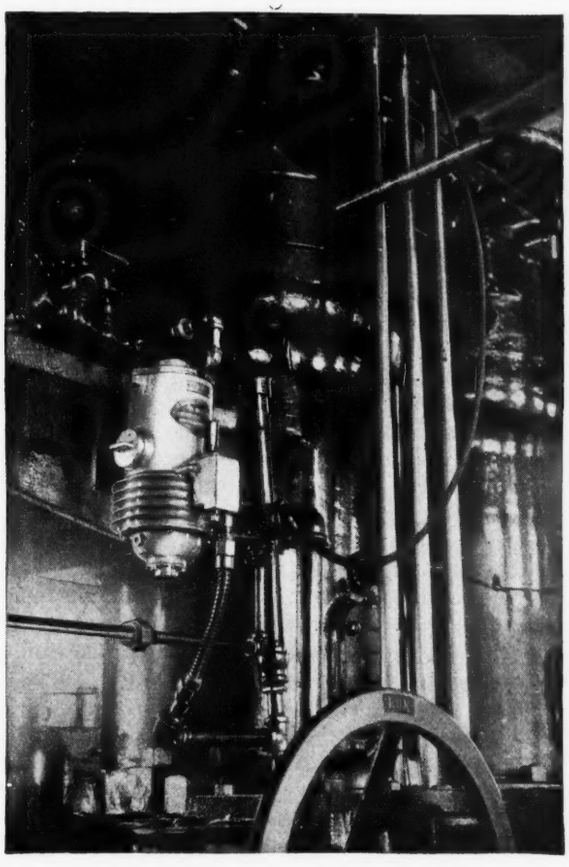


Fig. 2—A single shell-and-tube condenser used

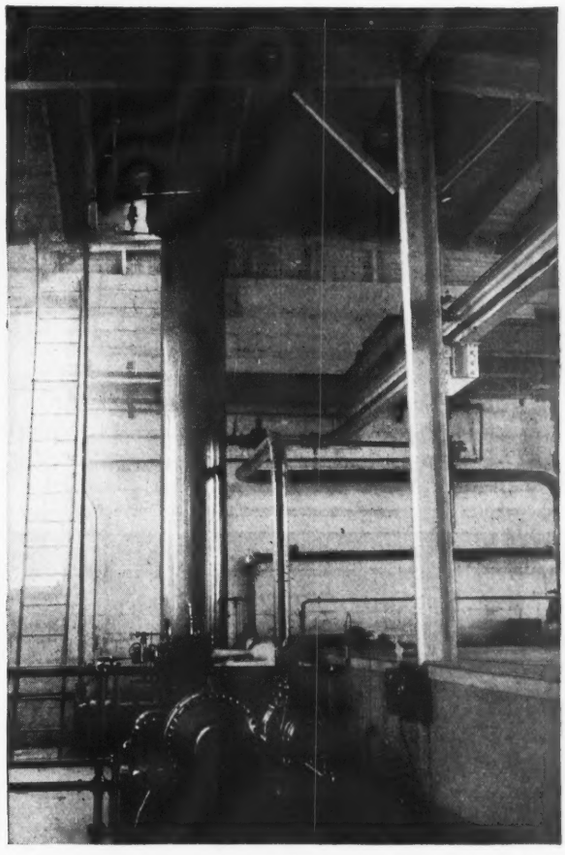


Fig. 3—The centrifuge on the engine

The can water is taken from the city lines, as the plant's own water is not suitable for ice without treatment.

Air agitation is of course used; the air is supplied by an Allen & Billmeyer six-stage turbo blower direct-connected to a 3-hp. 1,800-r.p.m. motor. A 1¼-in. Viking pump pulls the cores.

A 6x5-in. Pennsylvania compressor is belt-driven at 400 r.p.m. by a 7½-hp. Lincoln motor to supply the air to operate the air lift in the well. The discharge line is run vertically to a level with the roof, where it ends in a steel drum open to the atmosphere. The entrained air is here free to leave, and the water flows out through a horizontal line to the condenser.

A small ice-storage room adjoins the tank, the door being shown in Fig. 5.

In this plant the engineer handles the entire operation, with a tank man to pull the ice; labor charges are consequently low. This, together with cheap power, permits the manufacture of ice at a cost comparable with the cost in the largest of plants.

The plant is run throughout the year—in the summer continually and during the winter often enough to keep the storage room filled. Since its installation no serious

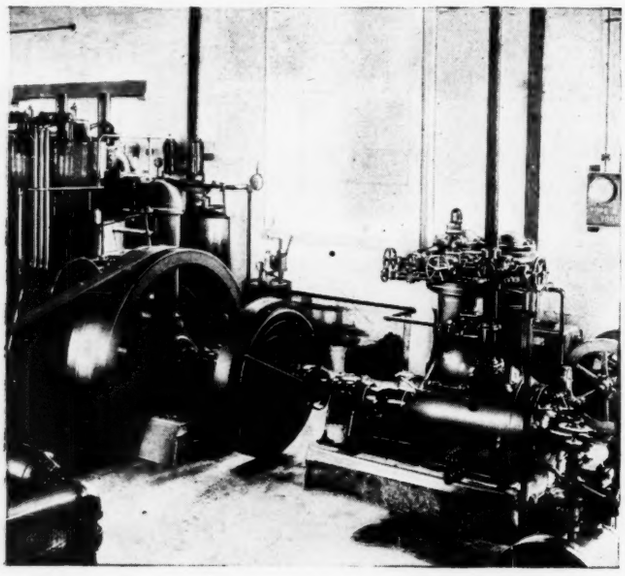


Fig. 4—The compressor is driven through a clutch

plant trouble has occurred, even though some difficulties might be expected with a force unfamiliar with oil engines.

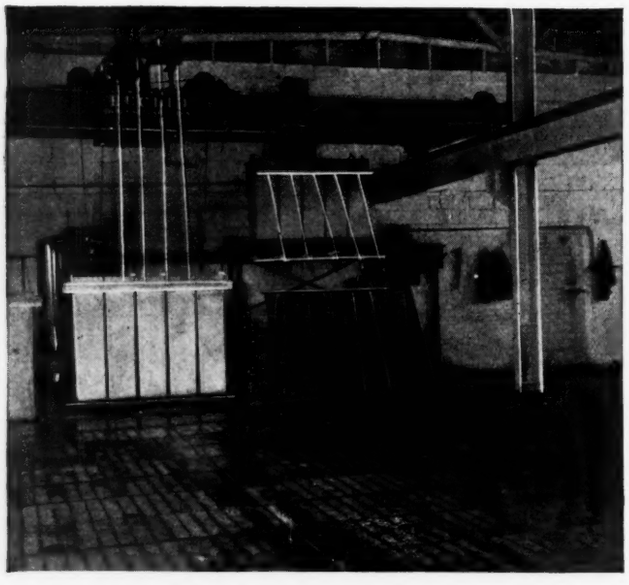


Fig. 5—The tank and can filler

It will be seen that the generator has a short drive belt without an idler. The belt has proved serviceable.

It is estimated that the cost of the engine will be paid for in three years out of the reduction in power costs made possible by its installation.

Letters from an Oil-Engine Operator

Why Exhaust Valves Score

Dear Ed.: You remember the argument we once had as to why an exhaust valve on the old Diesel scored. Well, I ran across a similar affair out here, and the arguments of two of the men reminded me of our own orations. Of course the case was a little different, for both Jack and Harry were wrong, while, you remember, I always acknowledged I was right in our little discussion.

Jack Faulkner and Harry Danner were looking at an exhaust valve that was badly burned—ruined, in fact. Jack maintained that it was due to having insufficient cam roller clearance, and Harry declared that it was neglect of grinding, pure and simple.

The valve was about 5½ in. in diameter, and it was one of the old type made of cast iron. On one side there was a channel cut through the seat as wide as your finger and half as deep. At different points around the seat there were a number of smaller channels, some of which were no larger than the lead in a pencil.

Had this valve started to leak as the result of neglect to grind it, the main channel might have been cut by the flame, but the others would not. It was apparent that whatever had started the main channel had started a number of smaller ones, and that is not characteristic of valves that have not been ground until they begin to leak.

On the other hand, it could not have been the result of having the clearance cut too low, for when that happens and the valve stem expands until the valve does not close, the intense heat of the leaking gas will cause a still greater expansion of the valve stem. Under such conditions the heat will travel up the valve stem until the stem expands, and seizure will occur at the guide. The greatest force applied to the valve stem occurs when the cam is forcing it open, therefore the valve will be opened and will jam so that the spring cannot dislodge. With the valve wide open there will be no compression, the engine cannot fire and there will be nothing to burn the valve. You see I am repeating my old arguments.

This channel under discussion was cut as the result of many passages of fire through it. True enough, this could have been the result of a leak starting, but there were the smaller channels to account for.

There was but one logical reason for the several channels. The engine had been receiving into the cylinder some non-combustible substance in the fuel or the air, and this substance had been sticking to the valve and seat, forming a hard crust that became heavier with continued operation. It finally became so thick that it could not withstand the pressure of combustion and the shock of the valve coming to a seat. The result had been that the crust cracked in several places and leaks started. At one point a piece of the crust must have fallen out, leaving a larger channel than the others, whereupon rapid leakage had caused this largest channel to burn the metal much deeper.

Aside from the argument in question, if the valve had been made of some nickel-chromium composition, the natural tendency would have been for the seat to remain clean, and leakage probably would not have started.

Well, at any rate I gave them my little spiel about as I gave it to you, and they turned on me. "Who asked you to put in your bill?" It reminded me of the old days.

E. O. Leseid.

Portable Recording Wattmeter

Saves $2,444 in One Year

By H. R. Platt and E. Adams
General Superintendent, Plant Electrician, Columbia Tire and Rubber Company Mansfield, Ohio

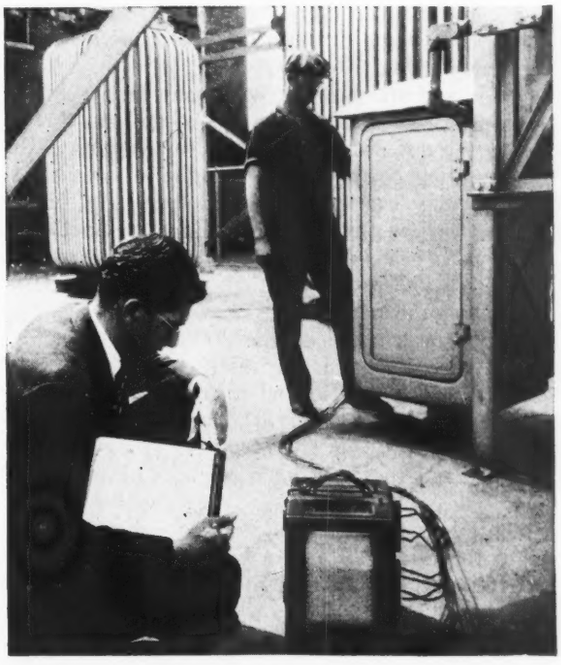
Studies made on the transformer and motor loads, with a curve-drawing wattmeter, showed large power losses that were not apparent before. After correcting these conditions, the yearly saving amounted to 8.2 times the original cost of the meter.

A PORTABLE recording wattmeter has been used to good advantage at the Mansfield, Ohio, plant of this company since August, 1927. New applications are constantly being found for this instrument, and substantial savings have already been effected through its use. The entire first cost of the meter has been returned 8.2 times by the savings effected in three typical cases in which poor operating practices have been detected by study of graphic wattmeter records.

This meter may be used directly on potentials from 110 to 550 volts and, by the introduction of potential transformers, on circuits of higher voltage. The main three-phase supply of the plant is 2,200 volts, and the meter has been applied to the primary circuits with satisfactory results on numerous occasions. Chart speeds of one, three, six or twelve inches per hour are frequently used, as are the faster rates of one, three, six and twelve inches per minute.

No regular testing schedule is followed, but the meter is kept busy about half the time. The plant has 120 motors of various sizes, ranging up to 400 hp., and individual load tests have frequently been made. Power input has been determined separately for several departments to assure a fair distribution of the total power cost. A small experimental mill is used for special runs on various lots of material, and the meter has proved useful in connection with this work.

Corrective measures resulting in substantial power and labor savings have been taken in several instances on the basis of information supplied by the wattmeter. Fig. 1 is a chart record of one of the first jobs on which the meter was used. The week-end load at the plant consisted of one motor only, a three-phase 440-volt unit rated at two horsepower. This motor operated continuously to drive the agitators in a battery of mixing tanks. Its use made it necessary to keep the main three-phase transformer bank on the line during a 36-hour period each week when the remainder of the plant was shut down.



Testing power-transformer load with a portable wattmeter

Power is metered on the high-voltage side of the transformers, so that core and copper losses are included in the monthly power bill. A test with the recording wattmeter showed an input of about nine kilowatts when there was no active load except the two-horsepower motor. Further tests showed that this motor was too large for its load and that a 1½-horsepower single-phase unit would drive the agitators satisfactorily.

At the present time the agitators are being driven by a single-phase, commutator-type, repulsion motor operated from a 220-volt lighting circuit. The present input, also determined with the wattmeter, is 0.605 kw. The net power saving is thus 8.395 kw., or 93.3 per cent, about 15,715 kw.-hr. for 52 weekly periods of 36 hr. each. At two cents per kilowatt-hour, the annual saving is $314.30. This alone is more than the entire cost of the wattmeter, and it does not include the additional saving made during normal operating hours as a result of the use of the smaller motor. The core loss of the small lighting transformers has been checked, but was found to be practically negligible.

A second interesting feature of the chart in Fig. 1 is the record it gives of the plant watchman's trips in one of the elevators. The watchman was found to be using the elevator at least three times an hour and some-

times oftener. This was entirely unnecessary and was stopped when it became the practice to cut the three-phase power transformers off the line over the week-ends. The recording meter was later used in a study of regular elevator operation, resulting in the elimination of unnecessary trips during plant hours at a saving of 10 per cent in elevator power cost.

Fig. 2 is a chart showing what may be accomplished in a study of peak-load swings. The mills in this plant are driven by one 200- and one 400-hp. motor. Studies of the operating cycles on these machines, with the help of the recording wattmeter, showed that proper instruction of the workmen could largely eliminate heavy peaks. By starting a cycle more promptly as the preceding one was finished, it was found that mill output could be increased and the demand curve considerably flattened.

This chart was taken on the 200-hp. unit before the operating procedure was definitely altered, but it has one section, marked "Normal operation," which corresponds closely to the present average load condition. The difference between load swings, from comparison of the left- and the right-hand sections of the chart, is marked.

A report by the local public utility indicated a power saving at the rate of $1,080 a year as a result of better load conditions and reduced overtime operation on the

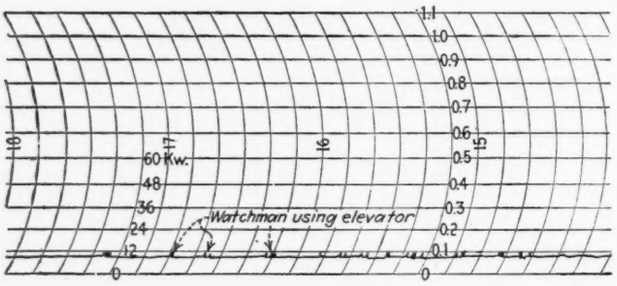


Fig. 1—Load on power transformers when supplying on two-horsepower motor

Chart shows primary power loss plus power required for two-horsepower motor. Peaks indicate elevator operation. A saving of $314 per year was made by disconnecting the transformer over the week end and operating the motor from the lighting transformers.

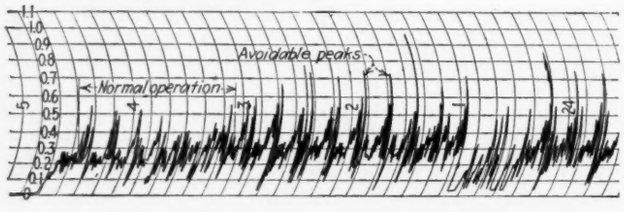


Fig. 2—Power-input curve to 200-hp. synchronous mill motor

Chart taken before instructing operators on proper sequence of operation. By starting one cycle at the end of the preceding one, without interruption, the peaks were ironed out considerably. It is estimated that the reduction in peak loads saved over $1,000 per year in power costs. The chart speed used in this test was three inches per hour.

mills. This is about 3.6 times the entire cost of the wattmeter which first showed the possibilities of improving the operating practice.

Further study of the mill loads showed that their characteristics would permit substituting synchronous motors for the induction type now used. This change, when put into effect, will raise the average plant power factor from 75 to about 95 per cent. A power factor change of 14.6 per cent resulting from a similar change in 1926 in another part of the plant, cut off $83 a month in penalty charges alone. It was shown at that time that correction of the power factor to unity would save an additional $92 a month.

Fig. 3 is a chart illustrating the use of the wattmeter to avoid disputes with piece-rate workers. A certain bias cutter operation was priced on the basis of 40 stokes a minute. The operators complained that the machine was operating at less than that speed and that they

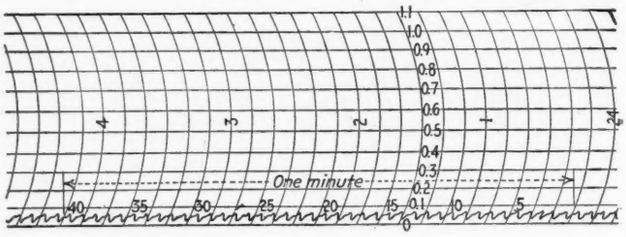


Fig. 3—Chart showing bias cutter speed

This chart was used to settle a dispute regarding the speed of the machine. The chart speed used in this test was twelve inches per minutes.

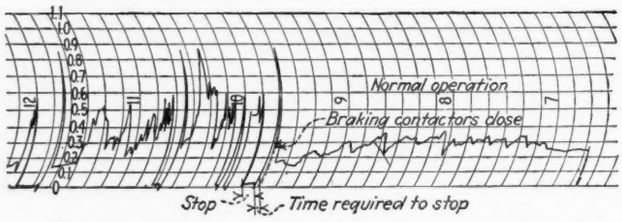


Fig. 4—Check test on 200-hp. synchronous mill motor to show performance of the safety stop

The chart speed used in this test was three inches per minute.

could not satisfactorily make the intended rate. A check with the recording wattmeter satisfied the workmen easily. With its chart running at twelve inches a minute, the meter gave a clear and undisputable record of operation at proper speed.

Fig. 4 shows a chart taken on the same mill motor as the chart in Fig. 2, but with the record moving twelve times as fast. Its purpose is to check the operation of the safety stops. It also shows the amount of down time between cycles, and the right-hand portion, marked

SAVINGS MADE BY USE OF RECORDING METER

	Kw.	
Elimination of Transformer Losses		
Former input to mixer motor, including transformer losses, from wattmeter, test chart Fig. 1	9.000	
Present input from wattmeter record	0.605	
Net saving, 93.3 per cent	8.395	
Annual total, 8,395 kw. × 36 hr. × 52 weeks × $0.02 per kw.-hr.		$314.30
Reduction of mill Input		
By elimination of heavy peak loads and overtime operation of mills		
Utility company's estimate of annual saving		1,080.00
Better Supervision in Mixing Department		
Time saved in quicker starting, ¼ hr. per shift × 3 shifts per day	1 hour per day	
One hour per day × 6 men at $0.70 per man-hour	$4.20	
$4.20 per day × 250 days per year		1,050.00
Total savings		$2,444.30
Meter cost returned	8.2 times	

"Normal operation," bears out what has already been said in the discussion of the chart in Fig. 2 regarding the ironing out of large peaks in mill output.

Further applications for the recording wattmeter are constantly being discovered. In one department it was noted that the mixing mills did not start promptly at the beginning of each shift. A crew of six men was found to be losing about twenty minutes on each of three eight-hour shifts by failing to get started promptly. This cost the company two man-hours per shift, or six

man-hours a day—a loss of $4.20 at the prevailing rate of 70c. per man-hour. The correction of this condition is saving $1,050 a year, or 3½ times the cost of the recording wattmeter.

In another case the use of the recording wattmeter proved it possible to drive a second vacuum pump from a motor already in use on a vacuum pump of an identical kind. This was contrary to the pump manufacturer's recommendation, but has proved entirely satisfactory. The saving in this case is the entire installation and operating cost on a five-horsepower motor.

The accompanying table shows a summary of the savings mentioned. It should be remembered that these are but a few outstanding cases selected from the first eight months' experience with the instrument. The gross total shown is $2,444.30, about 8.2 times the cost of the instrument. The total operating cost on the meter, including fixed charges, cleaning, adjustments and supplies, averages less than $60 per year, less than 2.5 per cent of the gross saving shown on three of its many applications.

The meter used is a General Electric type CP-4 and was chosen after careful study of the testing requirements. Strong construction and light weight were important factors, affecting the ease with which the unit could be handled and moved about. It was also considered important that the meter be usable on circuits of all standard secondary voltages, and that it have a sufficiently wide range of chart speeds to make it useful in all types of investigations.

Changing a Two-Phase Motor For Three-Phase Operation

By M. E. Wagner

How a two-phase 100-hp. 2,200-volt 60-cycle eight-pole induction motor was changed to operate on 440 volts three phase may be of interest. The two-phase motor had 48 coils in 96 slots, connected in a concentric winding, part of which is shown in Fig. 1. Each coil had 12 turns of one No. 10 wire, wound two turns wide by 6 deep. The coils in each phase were connected 24 in series.

In the three-phase eight-pole winding there would be $48 \div 3 \times 8 = 2$ coils per pole-phase group. In the two-phase winding there were three coils per pole-phase group. This would require regrouping of the coils if they were to be used in the three-phase winding. To do this would require removing the coils from the slots and, even if this could have been done without injuring the insulation, part of the coils would be too small to use in the three-phase winding. It was therefore decided to make up a complete new winding for the motor.

It was also considered best to use a distributed-type winding, as in Fig. 2, instead of the concentric type. This new winding was to be made two layer, so that there would be 96 coils. These arranged in an eight-pole three-phase winding would give $96 \div 3 \times 8 = 4$ coils per pole-phase group. Full pitch of the coils is $96 \div 8 = 12$ slots, that is, if one side of a coil is in slot No. 1 the other side will be in slot No. 13. The coils would be divided equally between the three phases, making a total of $96 \div 3 = 32$ coils per phase.

The number of turns per coil was determined from the two-phase winding. In one phase of this winding there were 24 coils, each having 12 turns, or a total of $24 \times 12 = 288$ turns. Across these 288 turns, 2,200 volts was impressed, so that each turn was good for $2{,}200 \div 288 = 7.64$ volts.

The three-phase winding was to be used on 440 volts, then if each coil turn was good for 7.64 volts there would be required in each phase $440 \div 7.64 = 57.6$ turns in series. There are 32 coils per phase, so that each coil should have $57.6 \div 32 = 1.8$ turns per coil. This is for a delta-connected winding.

By connecting the winding in star it would have to be good for only 58 per cent of the line volts, or $440 \times 0.58 = 250$ volts. The winding would then require 58 per cent of the turns in series for a delta-connected winding, that is, $57.6 \times 0.58 = 33.4$ turns. One turn per coil would give 32 turns per phase and this would be close enough for practical purposes. By increasing the pitch of the coils one or two slots they could be made more effective and compensate for the small reduction in the number of turns.

The full-load current rating of the old motor was 22

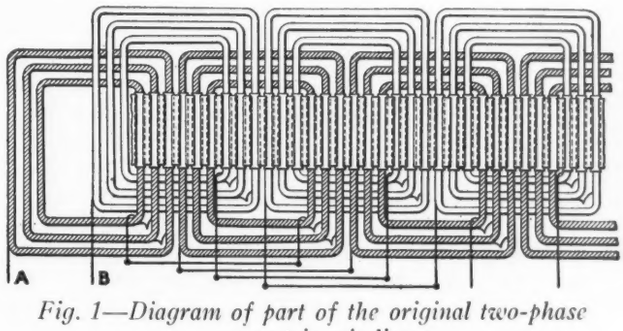


Fig. 1—Diagram of part of the original two-phase concentric winding

amperes. A No. 10 wire has a cross-sectional area of 10,380 circ.mils. Therefore, in the original winding $10{,}380 \div 22 = 474$-circ.mils cross-sectional area of copper was allowed per ampere.

The full-load current of the 440-volt winding would be equal to $(Hp. \times 746) \div (P.F. \times e \times E \times 1.732)$. The horsepower, $Hp. = 100$; the power factor, $P.F. = 0.85$; the efficiency, $e = 0.90$; and the voltage $E = 440$. Then the full-load amperes equals $(100 \times 746) \div (0.85 \times 0.90 \times 440 \times 1.732) = 130$ amperes. Allow-

ing the same cross-section of copper per ampere in the new winding as in the old gives 130 × 474 = 61,600 circ.mils. This is almost equivalent to the cross-sectional area of a No. 2 wire, and would be too large to go into the slots.

If six No. 10 wires are used in multiple, they would

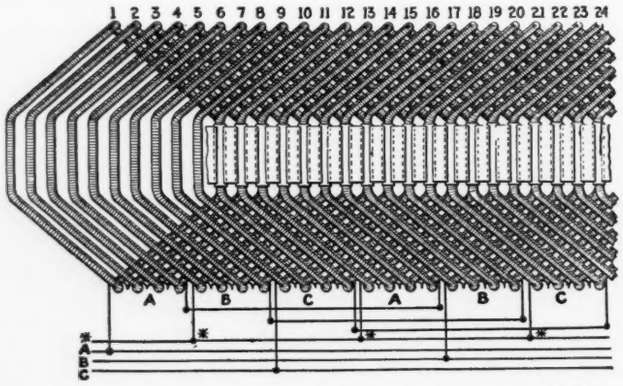


Fig. 2—Diagram of part of the new four-parallel-star three-phase distributed winding

have a cross-sectional area of 10,380 × 6 = 62,280, which would meet the requirements, but would make a difficult coil to wind. If the winding were connected two-parallel-star, the number of turns per coil would be doubled and the cross-sectional area of the conductors reduced by one-half. To meet this condition the coils might be wound with two turns of three No. 10 wires in parallel. Or they could be wound with two turns of

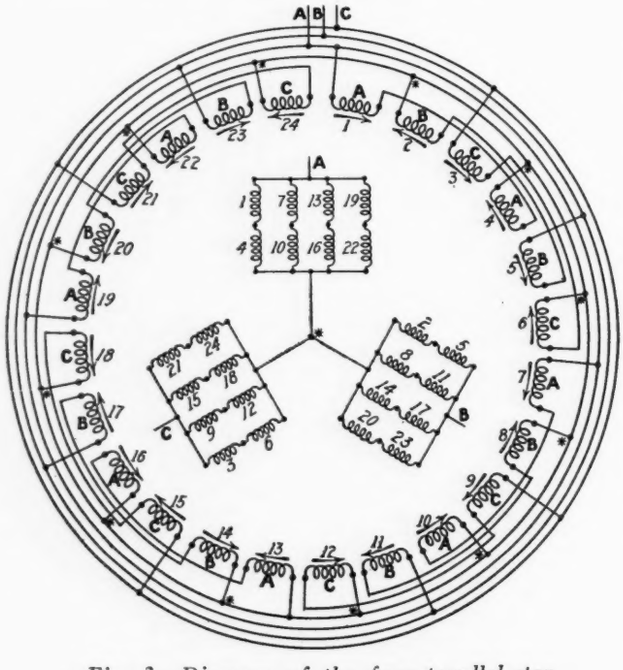


Fig. 3—Diagram of the four-parallel-star three-phase winding used in the motor

six No. 13 wires in parallel. By using a four-parallel-star winding, each coil would require four turns of wire having a total cross-sectional area of 61,600 ÷ 4 = 15,400 circ.mils. This is nearly equivalent to a No. 8 wire, which cannot be used in the slots. Three No. 13 wires in parallel would have a cross-sectional area of 5,178 × 3 = 15,534 circ.mils, and could be used.

A double-cotton covered No. 10 wire has a diameter of 112 mils, and two would occupy a space 112 × 2 = 224 mils wide. A No. 13 wire with a double-cotton insulation has a diameter of 82 mils and three wide would require 82 × 3 = 246 mils space. The six No. 10 wires deep occupied a space of 112 × 6 = 672 mils. In the new winding there would be eight No. 13 wires deep, which would require a space 82 × 8 = 656 mils. The three No. 13 wires wide requires 246 — 244 = 22 mils more space than that for the two No. 10 wires, but it was found that the slot insulation could be reduced sufficient to accommodate the three No. 13 conductors, and this winding was used.

From Fig. 1 it will be seen that the coil pitch of the two-phase winding varies from 1 and 8 for the small coils to 1 and 12 for the large coils. The average pitch is 1 and 10. In the new winding, to compensate for the small reduction in the number of turns, the coil pitch was made 1 and 11, as shown in Fig. 2. In Fig. 3 is a diagram of the connections for the four-parallel-star winding. This machine was connected in this way and operated satisfactorily.

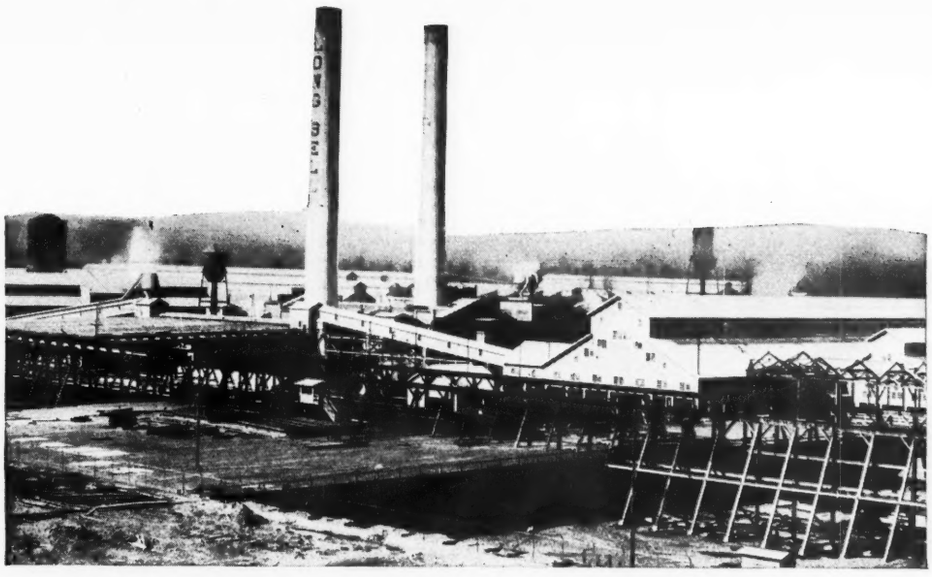
Best Efficiency with Synchronous Motors

By R. O. Brown

Synchronous motors are being used extensively in industry for a great many different drives. On this type of motor the power factor can be controlled and, to a certain degree, the efficiency. These motors are designed for operation at 80 per cent leading power factor or unity power factor at full load. With the field adjusted to give rated power factor at full load the power factor will decrease to the leading side when the load is less than rated value. This however in many plants is not objectionable.

When the load is made up almost or entirely of synchronous motors, the unity power factor type is usually installed. In such cases, operating the motors at unity power factor will give the best efficiency at all loads. The field losses can be reduced some by reducing the field current with the field rheostat. When the power factor is decreased below unity the stator current is increased for a given horsepower output, consequently the copper losses in the winding are increased. These losses increase faster than the field losses are decreased, therefore the net result is a decrease in efficiency.

Where two or more motors are excited from a common source, the exciter voltage should be carried as low as possible to give the desired power factor on the motors. If the motors are not identically alike, the exciter voltage should be adjusted to a value that will give the correct power factor on the motor requiring the highest excitation voltage. Then adjust the power factor of the other motors by their field rheostats. When operating under this condition the field resistance will be all cut out on one motor and there will be a small amount of resistance in series with the field of the others. This method of operation allows the minimum losses in the fields of both the exciter and the motors to obtain the desired power factor. If the exciter voltage is made too high, the losses in the field rheostats of the motors may amount to considerable and total up a surprising waste of power in a year.



East and west mills with power and air compressor plants in central location

Central Lubrication de Luxe in a Lumber Mill

Eight fourteen-feed lubricators on a central steel table with a total of 112 feeds and 7,000 ft. of ⅛-in. distributing pipe oil an entire mill. From underground storage ten different kinds of oil are supplied by the air-lift system. Cleanliness, minimum of waste and labor, and the lessening of the fire hazard are some of the many advantages.

OWING to the nation-wide publicity given to the town of Longview, Wash., by the Long Bell Lumber Company, whose plant represents the last word in sawmill construction and efficiency, countless visitors during the year are induced to make this a stopover point to be shown through the mill. One of the many attractions is the most complete and compact force-feed oiling system that has been put in operation in the country.

In the east fir head-mill is the largest of the central oiling systems used in this plant. Here eight fourteen-feed force-feed lubricators, with a total of 112 feeds, are mounted in a double row of four each on a specially constructed steel table. Down the center of this table is a shaft, taking a rocking motion from an eccentric arm on a motor-driven speed reducer. The lubricators get their motion from bell cranks on this shaft. Each pump valve, of course, is regulated independently to serve the desired condition at a bearing or cylinder in the mill. Distribution is effected through 7,000 ft. of ⅛-in. piping. Each feed line is numbered and tagged at the pump and at the point it serves, and a chart, placed above the table, gives the location or number of each point served, so that the control of the oiling can be placed under one man who is made responsible for operating the lubricators. To reduce the fire hazard, a most important factor in a lumber mill, the oil storage has been placed underground outside the building, where deliveries are made direct to a receiving platform by the trucks of the oil company. There are ten 420-gal. storage tanks, as there are that many different kinds of oil used in the mill, owing to the great variety and different types of machines requiring lubrication. These ten tanks supply oil for steam-cylinder lubrication, oil for air cylinders, oil for gear-reducing sets, oil for motors, and six different kinds of oil for bearing lubrication, two of the tanks being reserved for the motor and reducing-set oils, and the other eight for supplying the force-feed pumps.

As indicated in Fig. 1, each of the main storage tanks is connected with a small auxiliary tank of six gallons capacity by a two-inch pipe with a gate and check valve between, so that the small tanks are filled by gravity. From these small tanks to the force-feed lubricators and oil stations throughout the mill, the oil is handled by an air-lift system controlled by Osborne three-way air valves. The operation of transferring the oil from one point to the other is unusually simple, as it merely requires the manipulation of a valve.

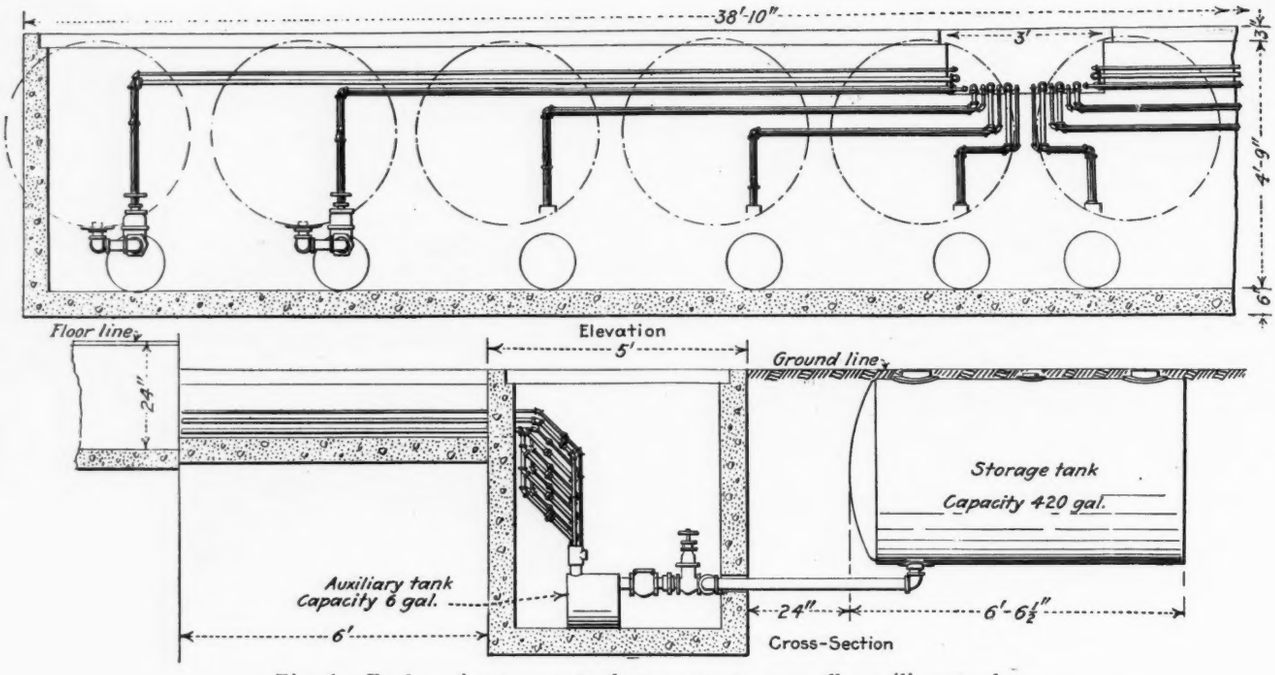


Fig. 1—Each main storage tank connects to a small auxiliary tank

It may be of interest to review briefly the type of equipment requiring lubrication. The steam units served by this oiling system are 36 in number, with 48 oil feeds, the units consisting of shotguns, niggers, log turners, skid "lits," etc. Every shotgun has five feeds, one on each valve, one on the valve controller, one on the piston-rod packing, and one in the middle of the gun. The general plan is to have a feed for each separate unit as near to the unit as it is practical to install it. In the mills of the east unit, the total number of air cylinders is 334. These cylinders are used to operate air trimmers, air lifts for bumpers, rolls, skid chains for hoisting saws, etc. Lubrication is effected by introducing one feed into a supply line serving several cylinders, the installation of the air supply line having been planned with this end in view. In the east unit 385 gear-reducing sets are in use. Band mills running at 377 r.p.m. and edgers at 1,200 and 1,800 r.p.m. are lubricated successfully from the force-feed system.

Separate entirely from this system is the lubrication of the power plant, the air-compressor plant, and the west unit of the mill. In this unit there are seven force-feed pumps, distributing through 6,000 ft. of ¼-in. piping to equipment similar to that already mentioned. Here there is no underground storage, however, nor is an air-lift system employed to transfer the oil. In this division of

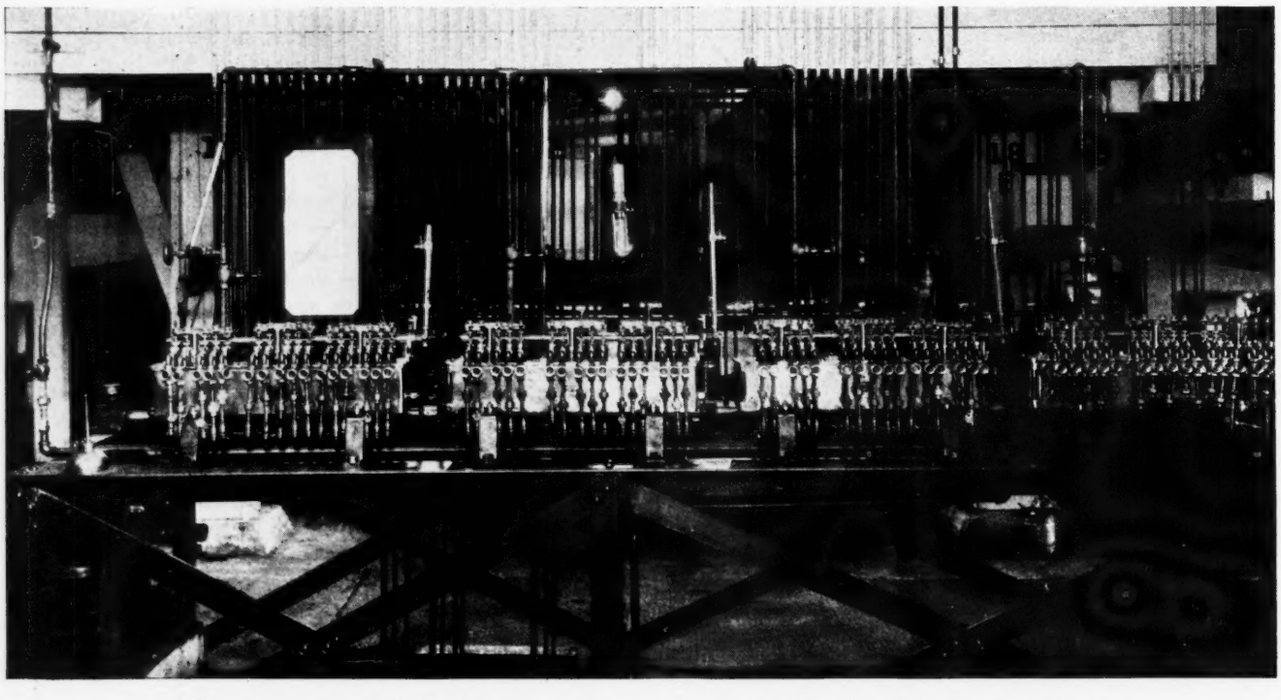


Fig. 2—Central lubricating system for east fir head mill, with eight fourteen-feed lubricators distributing through 7,000 ft. of piping

the mill oil is delivered to 526 air cylinders, 24 steam units, and over 400 gear-reducing sets.

In both divisions of the mill the force-feed pumps in use are Hills McCanna single-plunger lubricators. This type of lubricator has been accepted generally as well suited for sawmill lubricating systems, owing to the positive feed of the single plunger and the packed stuffing-box pump valve with no possible bypass, insuring positive feed against pressures built up through long, small-diameter pipe leads.

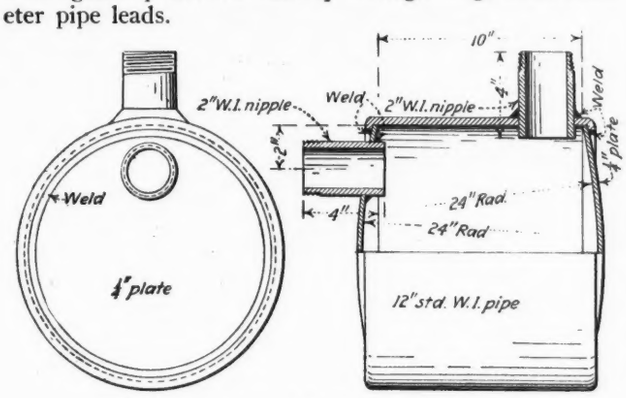


Fig. 3—Detail of 6-gal. auxiliary tank

The entire system and layout was designed by W. L Osborne, of the Los Angeles office of the Hills-McCanna company, in collaboration with the engineers of the Long Bell Lumber Company. Reports from these engineers are to the effect that the system has proved satisfactory in service. Decided preference is given to the latest system installed in the east unit, which includes underground storage and oil transfer by means of the air-lift system, as this requires a minimum of labor, both in the receiving and the transfer of the oil, the maximum of cleanliness, as the oil is moved in a closed system, and with no spilling of oil about the plant the fire hazard has been reduced to a minimum.

Cost of Detroit Municipal Plant

THE unit cost of the Morrell Street Plant, Detroit, was given as $105.17 per kilowatt in the table on page 402 of the Sept. 4 issue. This figure is correct if interpreted in the light of the following explanation made clear near the end of the article.

"The construction cost of the plant amounts to $105.17 per kilowatt, the principal subdivisions being given in the table. All costs applying to the ultimate capacity of the present plant building have been segregated under the heading of 80,000 kw., all other costs applying only to the present installed capacity have been segregated under the heading of 60,000 kw., the cost per kilowatt of present installed capacity having been determined on this basis. This cost per kilowatt is slightly higher than it will be for the completed plant of 80,000-kw. capacity, but is a true index of the cost as the project now stands."

While the results obtained are correct deductions from the data furnished to *Power*, the reader who attempts to check the table may be confused by two errors made in editing. One was the insertion of the words "additional cost" under the heading "80,000 kw." The figures in this column are not the *additional cost* but, as pointed out in the article, the *total cost* of those elements of the project (structures, for example) now complete for the full 80,000 kw. capacity. The total of this column divided by 80,000 gives $38.48 per kilowatt, which is the correct amount to allow for these items either in the present plant or the completed plant. The total of $4,001,537.00 for items applying solely to the present 60,000 kw. is also correct, if the subtotal for turbine generator units is corrected to $1,173,669.00.

Study of the total and "per kilowatt" costs will make it clear that the final figure of $105.17 per kilowatt is the same as will be obtained on completion of the 80,000-kw. station if items pertaining solely to the additional 20,000 kw. have the same unit cost as the corresponding items of the first 60,000 kw.

Where Does Your Plant Stand?

AWHILE ago the *Power* staff made a careful study of the outstanding wastes in the generation, transmission and application of the power services: electrical and mechanical power, steam, hot water, heating and ventilation, compressed air, refrigeration and those other services which the power engineer must deliver to the point of industrial application before the production man can turn out the goods. "Why is it", they asked, "that some plants are able to keep these services on such a high plane, while others barely get by? Why are power-service costs low in some plants and high in others?"

The study revealed seven paramount needs of the field, and the seven planks of the *Power's* platform are aimed specifically at these, that the normal improvement along these lines may be speeded up. This platform was launched and fully explained in the Sept. 4 issue. Its planks are now carried at the head of the editorial pages in each issue as a constant reminder. And to show that these are more than mere pious wishes for the wellbeing of industry, each issue contains at least one article specifically related to some plank of the platform.

Most of these articles deal with plants that have a record of accomplishment. Your plant is different, and has its own peculiar problems, but a knowledge of results obtained by others, and the methods they use, will smooth your path to the goal of cheaper and better power services.

Determination of Moisture in Steam by Electrical Conductivity

By M. E. Fitze
Test Engineer, The Milwaukee Electric Railway & Light Company

THE electrical method of determining moisture content of steam is based on the fact that the electrical conductivity of pure water is zero and that the conductivity of a condensed steam sample varies directly with the total amount of solids present in the sample.

Impurities in the steam are due to entrained moisture carried over from the boiler, which, it is logical to assume, will carry solids in the same proportion as the boiler water. This furnishes a means for artificially varying the amount of solids (or moisture) in a sample of condensed steam by adding measured amounts of boiler water to a condensed sample and then measuring the electrical conductivity.

Apparatus Required

For collecting samples of condensed steam and boiler water a condenser such as shown in Fig. 1 or its equivalent is required. The compactness, portability, ease of operation, reliability and low cost of this type of condenser recommend its use. It can be made up by any welder.

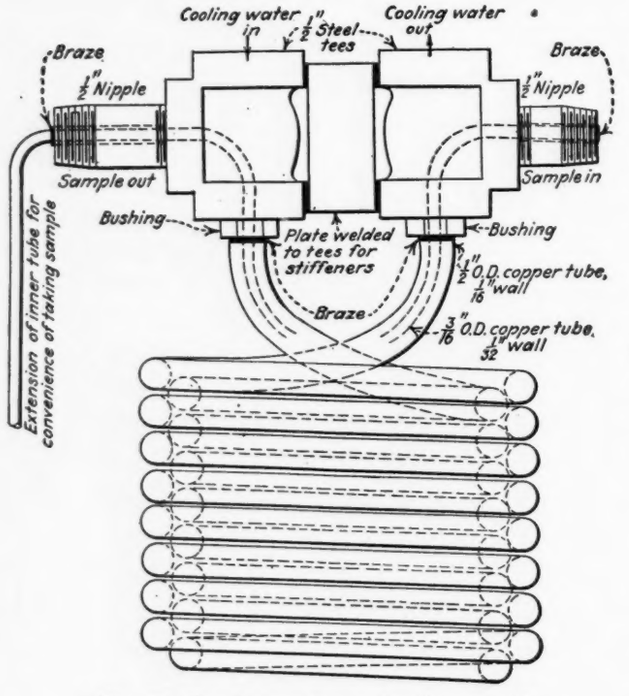


Fig. 1—Condenser for collecting sample

An apparatus for determining the conductivity of the samples is required. If an instrument measuring conductivity directly is not available, one measuring resistance can be used and the conductivity determined by taking the reciprocal of the resistance. The instrument in use at the Lakeside station is a Leeds & Northrup portable resistance meter using a portable dip cell.

A 2,000-c.c. flask and a 2-c.c. pipette are used for measuring samples while determining the calibration curve. A 500-c.c. breaker is used in routine collecting of condensed steam samples for measuring their conductances. A thermometer is required in keeping a uniform temperature of the samples while conductances are being measured.

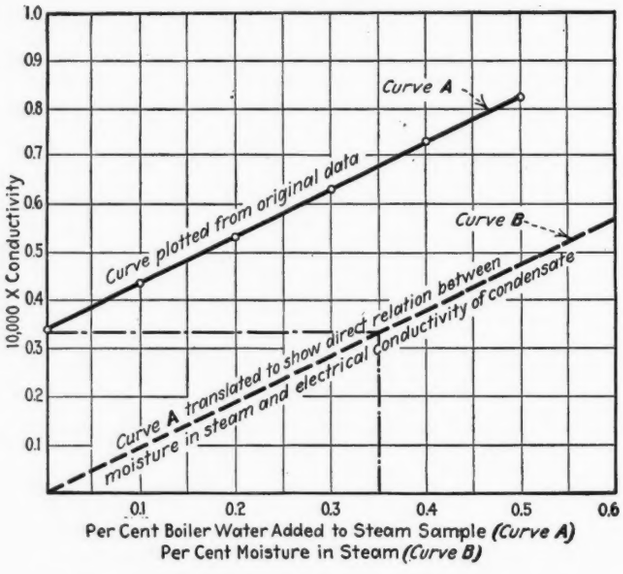


Fig. 2—Calibration curve for determining per cent moisture from conductivity

Determining and Using the Calibration Curve

After the condenser has been thoroughly flushed out and adjusted to give some uniform condensate temperature of, say, 70 deg. to 90 deg., thoroughly rinse the flask and other apparatus that is to be immersed in the sample and collect 2,000 c.c. of the condensate. Be careful not to let it flow down the side of the flask, as the resulting aëration would seriously affect the results. Now take boiler water that has previously been sampled with the condenser coil to prevent flashing and add it to the condensate in 2 c.c. amounts (0.1 per cent of sample). After each addition, thoroughly mix it with the condensate and then measure the conductivity of the mixture.

Fig. 2 shows a sample set of calibration data plotted to determine the amount of moisture (boiler water) in the

condensate samples. After the first curve *A* has been drawn, a second curve *B* is drawn parallel to the first and passing through zero to show the direct relation between moisture in the steam and conductivity of the condensate. This second curve can be used directly if desired or can, for more accurate work, be transferred to another sheet with larger scales.

If a meter is used that reads in units of resistance instead of in units of conductivity directly, the calibration curve can, by taking the reciprocal of each conductivity value, be plotted between units of resistance and per cent moisture in the steam, as shown on Fig. 3. This makes it possible in routine work to obtain moistures directly from the original resistance readings without first finding their reciprocals.

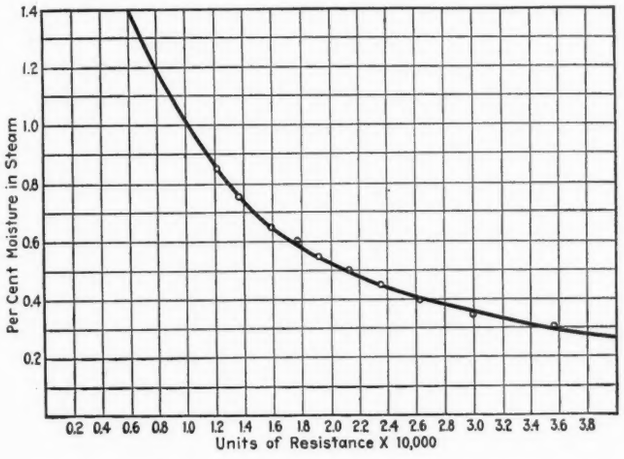


Fig. 3—Calibration curve for determining per cent moisture from units of resistance

Since the calibration curve is a straight line, it can obviously be determined with but two points, the original condensate sample, zero boiler water addition, and the addition of, say, 10 c.c. of boiler water, 0.5 per cent to the original sample. If time permits, however, one or more of the intermediate points are desirable as a check on the accuracy of the measurements.

Where boiler water conditions remain fairly uniform, the same calibration curve can be used with a fair degree of accuracy for from eight to ten hours; it should not be used longer than this without checking.

In routine sampling of the steam, the 500-c.c. sample is taken at whatever time interval is desired and its conductivity measured. The moisture content of the steam is then read directly from curve *B* Fig. 2 or from Fig. 3 if a resistance meter is used.

The temperature at which conductivities are measured should be within one degree of that at which the calibration curve was obtained, and extreme care must be exercised not to contaminate the sample with any kind of foreign matter. In case unavoidable temperature variations occur, a temperature correction curve can be developed by taking samples with different amounts of boiler water and varying the temperature over the desired limits.

With the apparatus conveniently arranged it is possible to take a sample each minute and measure its conductivity or resistance. Fig. 4 shows a series of moisture determinations taken at short intervals on the 1,300-lb. pressure boiler at Lakeside, using both the electrical method and a calorimeter. Further reference will be made to this figure later.

Accuracy and Reliability of Method

The advantages of this method of moisture measurement were forcibly demonstrated by test work that was done on the 1,300-lb. pressure boiler at Lakeside. A great deal of difficulty was experienced in trying to measure moisture in the steam from the boiler by using calorimeters. Satisfactory results were never obtained with calorimeters because of inability to determine a thoroughly reliable calorimeter "normal." Coupled with this difficulty was the ever-present doubt as to steam chart accuracies, and the need of continual application of large pressure corrections.

Reference to Fig. 4 will show a comparison between moisture measurements taken simultaneously by calorimeter and electrical conductivity methods. It will be noticed that the electrical method indicates a uniform moisture content over the entire period, while the calorimeter moisture fluctuates rapidly between quite wide limits, though pressure variations averaged about 10 lb. Toward the last the calorimeter moisture will be noticed to be varying too widely and rapidly to be considered even in an average, because of sudden pressure swings.

It has been suggested that the accuracy of this method would be impaired because of high concentrations near the water surface. In cases where oils and organic matter in large amounts have to be contended with, this could very well be the case; however, with reasonably good boiler water conditions it can surely be depended upon for reliable moisture results. Water samples taken from three different elevations of Lakeside's 1,300-lb. boiler, one of them within about 18 in. of the water surface, all showed practical agreement of the analyses. Moreover, knowledge of cleanliness of steam, not its moisture necessarily, is most desired, and the method gives a means of determining cleanliness directly.

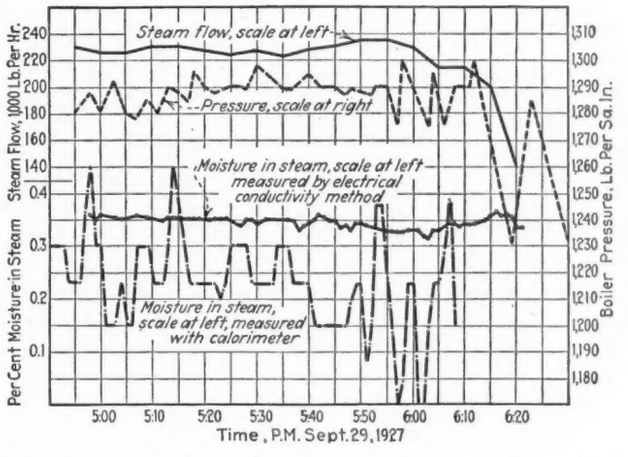


Fig. 4—Comparison of per cent moisture as determined by calorimeter and conductivity

Freedom from errors due to sudden boiler-pressure variations and steam-chart inaccuracies, together with elimination of calorimeter difficulties, especially at high pressures, seem to justify further study and wider adoption of the electrical conductivity method of determining moisture in steam as delivered by the boiler.

BURNING CRUSHED COAL *in Suspension*

By John F. O. Stratton
Stratton Furnace Company

Boiler furnaces burning crushed coal suspended in an upward blast of air within an incandescent furnace have been in operation for two years under commercial conditions. The principle of air separation is employed in a way to take advantage of variations in the specific gravity and volume of the coal and its constituents during combustion.

WHEN a piece of coal is injected into an incandescent furnace or an atmosphere maintained at a temperature of 2,700 deg. F. it changes rapidly to a spongy mass as the heat is absorbed. The coal blooms; its volume increases partly from the direct effect of the heat and partly because the released volatiles force their way to the surface and make the lump porous.

Fig. 1, *A*, shows a piece of cold coal of quarter-inch size, while *B* shows the same piece in a condition of incandescence. If the quarter-inch cold piece shown were dropped down a vertical pipe through which an upward blast of air was passing, an air velocity of 4,450 ft. per min. would be required to hold it in suspension. Should the coked and incandescent piece *B* be dropped down the same pipe it would require an upward air blast velocity of 2,530 ft. per min. to suspend it at the start. If the lump were allowed to cool, without combustion, to the condition of cold coke an air velocity of 4,000 ft. per min. would support it.

Exposed to furnace temperatures ranging up to 3,600 deg. F., the non-combustibles liquify, forming particles much denser than the original coal. The upward blast velocity of 2,530 ft. per min. will not suspend the solidified particles. As a result the non-combustibles fall down through the upward blast while the carbon combines with the oxygen of the air.

All of the foregoing is equally true of coal pulverized to 200 mesh size, except that coal reduced to this fineness can be suspended, even when cold, by the slightest upward movement of surrounding air. In this case, as before, the ash or non-combustible liquifies and falls to the bottom of the incandescent chamber or furnace.

As it is impossible to crush coal to a maximum of quarter-inch screen size without a considerable portion

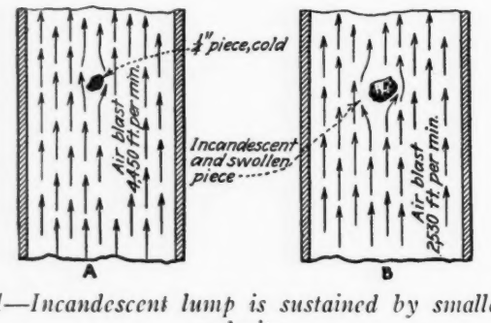


Fig. 1—Incandescent lump is sustained by smaller air velocity

of the entire quantity crushed being smaller, the furnace or combustion chamber must be designed to provide upward velocities of air and gas to suspend all of the various sizes of incandescent coal from quarter-inch screen to 200 mesh. This is accomplished by making the bottom of the furnace in the form of an inverted pyramid of rectangular section with a longitudinal slot at the extreme bottom of the chamber, as shown in Fig. 2.

At the bottom of the furnace, a space of 24 in. between the inclined sides allows two sets of grate bars to support a fuel and ash bed about 4 in. thick. This bed is constantly maintained and provides the necessary heat at the extreme bottom of the furnace for reducing every particle of coal to coke and furnishing primary ignition.

The grate *A* reciprocates continuously with a stroke of 4 in. This movement forces all of the coke and ash into the slot *B*, through which an upward blast of air at a velocity of 2,530 ft. per min. is maintained. The coke is blown upward into the furnace, while the ashes, because of their greater specific gravity, fall into the ash pit below.

Slot *B* is adjustable to permit various air volumes to be delivered to the furnace at constant pressure. A blower maintains an ash pit pressure of 0.4 in. of water.

Coal crushed to quarter-inch screen is fed to the furnace through a suitable nozzle at *C*. At this point a small air-blast nozzle admits sufficient air to burn the finer particles immediately, as in pulverized-coal systems.

The larger pieces are burned at various points between the nozzle *C* and the grates *A*. The distance between the nozzle and the grates is made sufficient to allow time for the coal to be coked before it reaches slot *B*.

Since the smaller sized pieces, from 70 to 200 mesh, must be burned between the nozzle and the boiler tubes or heat-absorbing area *D*, the design must provide for the necessary time element. This determines the height of the furnace.

The highest upward velocity of the air and gases is at the bottom of the furnace. The lowest velocities are established near heat-absorbing areas. The velocity of air through the slot is continuously maintained at 2,530 ft.

per minute. A draft of 0.02 in. is carried in the furnace with gas velocities from 700 to 900 ft. per minute.

Combustion air is preheated by passage through the cast-iron section surrounding the throat at the bottom of the furnace *E*, incidentally keeping these sections cool The air is then discharged into the ash pit (where it is further warmed by the heat of the ashes) and passes upward toward the slot in counter flow to the ashes falling into the ash pit. Finally, the heat of the grates and the radiant heat of the bottom of the furnace raises the temperature of the air to about 1,400 deg. F. before it comes in contact with the coal.

Experience has indicated that the furnace volume must be based on the quantity of coal to be burned. A heat release of 26,000 B.t.u. per hour per cubic foot is normal while combustion rates as high as 42,000 B.t.u. per cubic foot have actually been attained, the latter accompanied however by excessively high furnace temperatures for the refractories used.

The ash discharged is of even size, ranging from about $\frac{3}{16}$ in. down to $\frac{1}{16}$, with little dust. The maximum combustible content of the ash is 12 per cent, with an average of 9 per cent.

Slag accumulations are prevented by the continuous discharge of the ashes and by maintaining a temperature over 1,100 deg. F. on the inclines at the bottom.

Due to the upward blast from the bottom of the furnace the gases are kept in a constant state of turbulence. Counter flow of the fuel and the air supply compels each particle of coal to pass through fresh oxygen zones from the nozzle to the bottom. The reciprocating motion of the slot between the moving grates contributes to turbulence.

A banked fire condition may be maintained on the grates for any length of time with a minimum coal consumption.

The fire is started by simply throwing some burning waste on the grates, or starting a small wood fire, and then slowly starting the coal feeder.

The prime object of this system is to reduce the power and maintenance costs of coal preparation. Crushing run of mine coal to pass through $\frac{1}{4}$-in. screen has been accomplished with a power consumption averaging 2 kw.-hr. per ton. The coal and ash-separating mechanism of the furnace shown in Fig. 2 require 2 hp. and the coal feeder consumes about $1\frac{1}{2}$ hp.

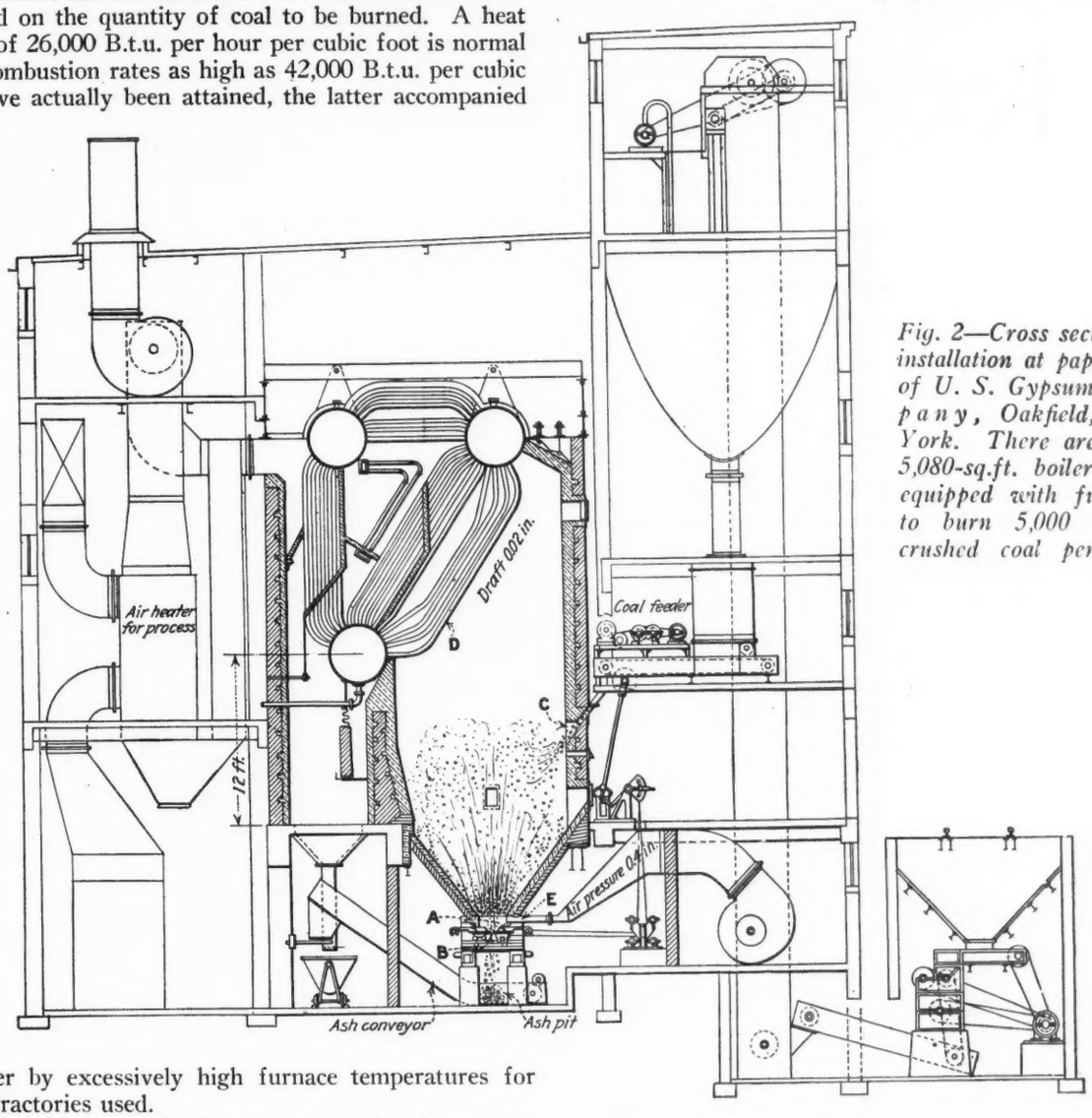
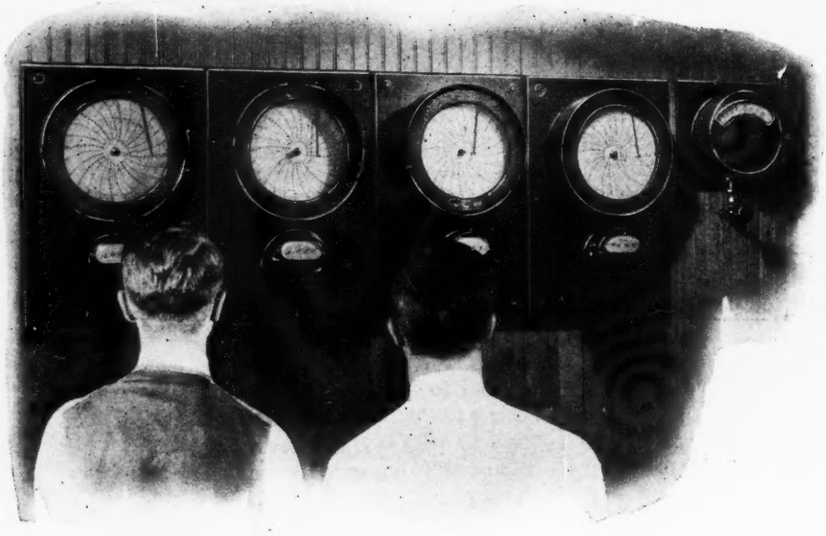


Fig. 2—Cross section of installation at paper-mill of U. S. Gypsum Company, Oakfield, New York. There are three 5,080-sq.ft. boilers each equipped with furnaces to burn 5,000 lb. of crushed coal per hour

Oil Engine Piston Rings

An oil engine is no better than its piston rings. In the Sept. 25 issue O. W. Jennings will show how to fit rings for gas-tight operation—and he will give the reasons for the various operations he recommends.

Selling *the* Meters



In the Industrial Plant

By M. J. Hess

Assistant Plant Engineer,
T. M. Sinclair & Company, Ltd.

UNTIL an industrial plant puts a man to work selling its meters, there will be officials dissatisfied with the results the plant is obtaining. I mean a real meter salesman, not the man who comes around to your office with a briefcase full of pretty pictures and graphic results. The latter's work is comparatively easy. He deals with educated and trained men, often with men who realize the value of his instruments far more than he himself. My meter salesman is the man whomever he may be—chief engineer, head fireman, chemist or clerk—upon whose shoulders rests the responsibility of selling the value of the instruments to the men who use them.

In nine cases out of ten he is responsible for the failure or success of your instruments, and I count as failures any instruments not used advantageously. No matter how carefully charts are read and readings taken, an instrument is not a good investment unless someone is noting conditions with an eye to improving them. Obviously, an instrument that is used as a check on operations does not pay so large a dividend as a meter used intelligently by the operator in eliminating undesirable conditions.

The Boiler Room Instruments

Consider the boiler room. It has got along for 30 or more years with hand firing, manual control and only the steam gage and water glass for instruments. Finally, the management purchases a flock of CO_2 meters and perhaps a few automatic control devices.

A crew of mechanics and perhaps an instrument man from the factory descend upon the boiler room with their wrenches and pipe. In a few days they leave, and on the wall of the boiler room resplendent in shining nickel are the CO_2 recorders. The head fireman has seen one in the public utility's boiler room, and that is about as far as his knowledge goes. The firemen are told that a short red line means they have a good fire, but they are suspicious and maintain that they always did have good fires. The chief engineer is too busy to give the matter much attention, but resolves to give any fireman "Hail Columbia" who turns in a bad chart.

This is the point where the real meter salesman should come upon the scene. Fortunate is the plant that has a mechanical or chemical engineer who can be assigned to the job, for this is a technical subject, although it must be worked out in a non-technical way. If given the right sort of intelligent care, the instruments will save their cost over and over, and certainly the proper persons to use them are the operating men.

The Selling Campaign

What should the salesman do and how will he attack this sales problem? The task is not so much different from selling encyclopedias to the farmers or brushes to the housewife. The salesman must possess two fundamental requisites—he must know his stuff and must possess personality, sales potentiality, or whatever other name you may choose to apply to that combination of common sense, patience and perseverance necessary to the success of any salesman. Probably above all, he should know his stuff, because nothing is so detrimental to a salesman or a teacher as a hesitant or bluffing manner.

There are several lines of attack open to the ambitious salesman. Education is one, advertising another and an incentive wage plan is another. For the best results a combination of the three methods is probably best.

Most humans have within them a desire to do their work correctly. You can hardly expect them to do things right unless, first of all, someone shows or teaches them which way is right, and even then they should have some instrument to tell them just what kind of work they are doing. With some individuals this information is all

that is needed and then pride will cause them to show a good performance. Other individuals must be sold on an idea, some of their sensibilities must be aroused. The product must be advertised. Other individuals work when they can see a personal gain for any additional effort or accomplishment.

Whatever method is selected for an individual plant, the use of daily bulletins is of marked assistance. Most meter companies are decidedly lax in their follow up, and this is one place where they could materially increase their value to industry and assure for themselves more satisfied customers.

When instruction seems to get boresome, the salesman should post some advertising bulletins to arouse interest and perhaps a joke or two to illustrate the point.

Such service could be issued free for three or four months after the installation, and most firms would be glad to continue the service by subscription. In lieu of such service it is up to the plant salesman to make use of his pencil and get out a few bulletins of his own. This takes time, but it is worth the trouble.

The meter man who will get out a bulletin service with daily bulletins to be posted directly on the meters, giving instructions, illustrated sales talks and an occasional joke, will perform a real service and get results. Bulletins of this type are shown in the illustration. Of course, they do not solve the whole problem. The personnel-example method should be used, pointing out errors and means of correcting them. Sales talks must be given either to groups or individuals, and the firemen taught to take an interest in the meters.

The Incentive Wage

The incentive wage plan calls for more time and attention than the other two, but its results are likely to be gratifying, especially when used with the educational and advertising method. This system need not be very complicated. Boiler efficiency is largely dependent on efficient combustion, which can be quite closely determined from the CO_2 readings. It remains, then, to set a standard for existing installations, calculate the savings to be made by attaining better CO_2 readings and then figure an equitable distribution of the saving. Bulletins could play their part by arousing interest in the bonus and possibly stirring a bit of rivalry between shifts.

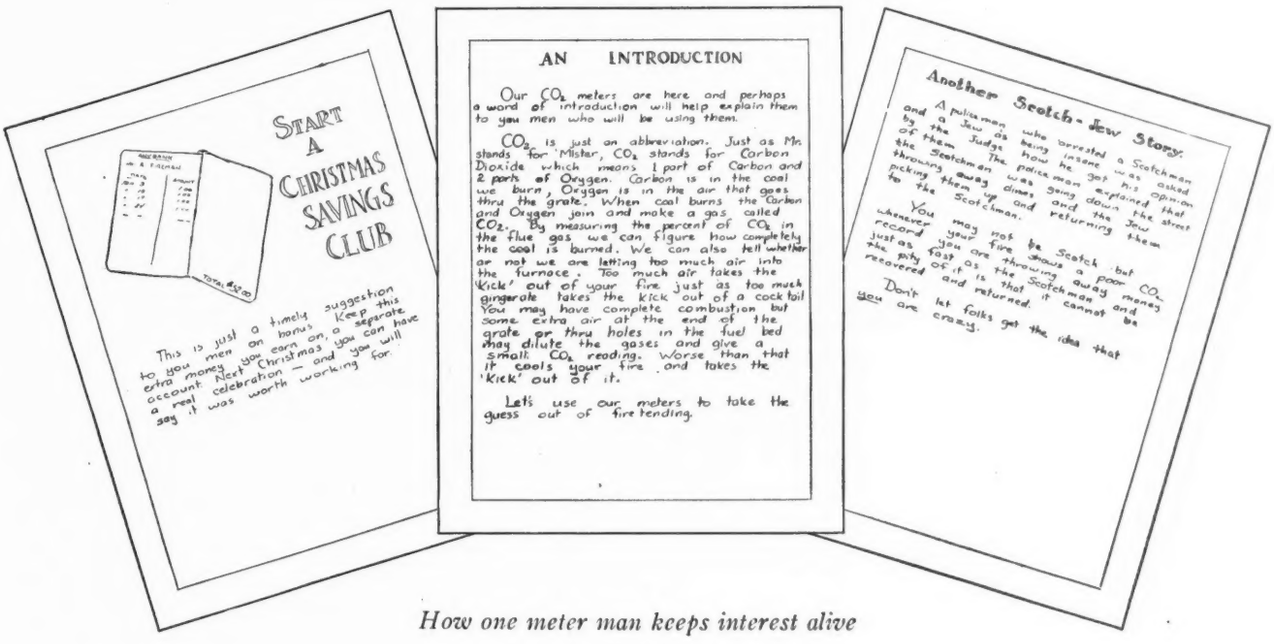
Here again the meter companies could lend assistance by furnishing an incentive wage, an outline of which could be arranged in so flexible a form as to be applicable to almost any type of boiler or kind of fuel. Bulletins again could play their part by arousing interest in the bonus and possibly stirring a bit of rivalry between shifts.

Does the task sound easy? Is it enough to install a few meters and trust to luck that they will sell themselves? I do not think so. The company that will give as much attention to this salesman as they do to their regular sales force, that will train such a man if it does not have one, will be taking a step in the right direction. There are correspondence courses and books on the subject of combustion written in such a way that a man with average education and intelligence can do much to improve conditions and grasp the general idea. An ambitious chap with such help would be a solution to the problem for a firm that could not hire a technical engineer.

The Man You Want

It is not necessary that the meter man have deep technical knowledge on the subject of meters. What is needed most of all is an understanding of how the average fireman thinks and of how to appeal to his sense of values. A mention of the pounds of coal saved causes more of an impression than figures on the thermal efficiency or on the heat units recovered. The operating force must be sold the idea of meter use, and unless the meter man can get over this idea his time will have been wasted.

Look up your meter salesman. Find out what type of individual is doing this selling for you. Is he the conscientious, energetic man whom you would hire for your regular sales force? If not, you are wasting your money, and the quicker you get a real salesman for the job the sooner will your instruments begin to show the return you should rightfully expect.


START A CHRISTMAS SAVINGS CLUB
This is just a timely suggestion to you men on bonus. Keep this extra money you earn on a separate account. Next Christmas you can have a real celebration — and you will say it was worth working for.
AN INTRODUCTION
Our CO_2 meters are here and perhaps a word of introduction will help explain them to you men who will be using them.
CO_2 is just an abbreviation. Just as Mr. stands for 'Mister', CO_2 stands for Carbon Dioxide which means 1 part of Carbon and 2 parts of Oxygen. Carbon is in the coal we burn, Oxygen is in the air that goes thru the grate. When coal burns the Carbon and Oxygen join and make a gas called CO_2. By measuring the percent of CO_2 in the flue gas we can figure how completely the coal is burned. We can also tell whether or not we are letting too much air into the furnace. Too much air takes the 'kick' out of your fire just as too much gingerale takes the kick out of a cocktail. You may have complete combustion but some extra air at the end of the grate or thru holes in the fuel bed may dilute the gases and give a small CO_2 reading. Worse than that it cools your fire and takes the 'kick' out of it.
Let's use our meters to take the guess out of fire tending.
Another Scotch-Jew Story.
A policeman who arrested a Scotchman and a Jew as being insane was asked by the Judge how he got his opinion of them. The policeman explained that the Scotchman was seen diving down the street throwing away dimes and returning them picking them up and returning them to the Scotchman.
You may not be Scotch but whenever your fire shows a poor CO_2 record you are throwing away money just as fast as the Scotchman and the pity of it is that it cannot be recovered and returned.
Don't let folks get the idea that you are crazy.

How one meter man keeps interest alive

Right Out of the Plant

BOILED-DOWN EXPERIENCE PASSED ALONG TO THOSE WHO MUST SAVE MONEY, IMPROVE THE PRODUCT AND KEEP THE PLANT RUNNING

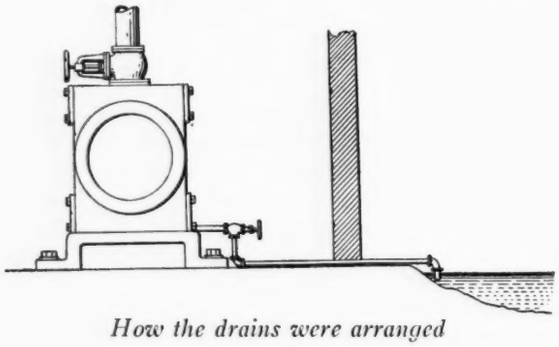
Cylinder Drains Damage Engine

I WAS witness to a peculiar cause of water in the high-pressure cylinder of a steam engine recently. The water seriously damaged the cylinder and piston rod.

The drain pipes from the cylinders ran outside the engine room and discharged over a pond. In normal times the pipes were well above the water, but a flood had raised the level and the ends of the drain pipes were submerged. The stop valve was closed to stop the engine, and before the latter came to rest, the drain cocks were opened.

Owing to the vacuum in the cylinder, a vacuum was created in the drain pipe and water was drawn up into the cylinder.

The position of the drain pipes was afterward altered, but this accident shows how carefully the exits of drain pipes should be chosen. If they are laid out so that



How the drains were arranged

water can collect in them the water may be drawn into the cylinder by the vacuum if the engine is rotated with the steam stop valve closed and the drain cocks open.

Brentford, England. W. L. WARNER.

How a Steam-Driven Induced-Draft Fan Was Converted to Motor Drive

WHEN our plant was built, two engine-driven induced-draft fans were installed to handle the flue gases from seven 6,000-sq.ft. boilers. The stokers were driven through a lineshaft and vertical steam engine. An open heater was used for heating the feed water, and all the auxiliary engines exhausted to it. The vapor from the evaporator was also condensed in the heater, this amount of exhaust steam being sufficient to raise the temperature of the feed water to approximately 170 deg. As this temperature was too high to get the best result from the economizers, we decided to install a motor drive on one of the induced-draft fans and thereby reduce the amount of steam discharged to the heater.

As it had never been necessary to run the fan up to its full speed to give the required draft on the boilers, we decided to utilize a 50-hp. motor that was available instead of buying one having the same horsepower as the engine, the motor to be connected to the engine through a silent chain.

The general arrangement of the drive is shown in Fig. 1 and the details of the sprockets and guard in

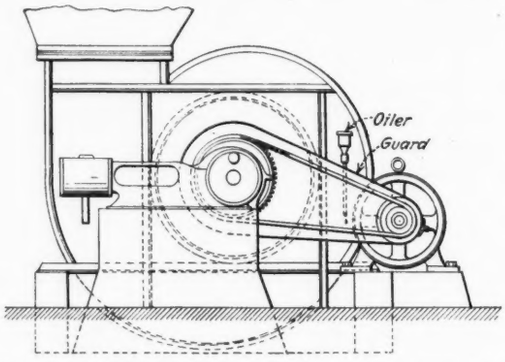


Fig. 1—General arrangement of the motor drive

Fig. 2. The sprockets and chain were purchased from a reputable chain manufacturer, the larger sprocket being split and having an inside diameter to fit snugly on the outside of the coupling, which joined the engine and fan shafts. This made an ideal arrangement, as it did not necessitate any change in the engine, and by disconnecting the chain the engine could be run with the sprocket in place. To augment the clamping bolts as a means of

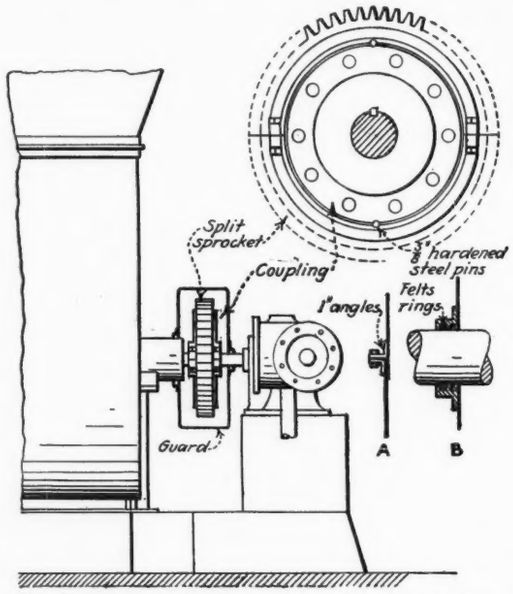


Fig. 2—Details of the large sprocket and chain guard

holding the sprocket tight on the coupling, two ⅜-in. hardened steel pins were inserted as shown, half in the coupling and half in the sprocket.

Special attention was given to the construction of the guard to protect the chain from dust and also to the lubrication of the chain. The guard, or chain housing, was made of No. 24 gage iron with 1-in. angles along the

joint. The upper half of the housing was made to extend below the joint, and a felt gasket was glued to the upper angle. The detail of the sealing ring used on the rotating engine shaft is shown at *B*.

The only change made in the engine was to disconnect the crank and remove the halves of the bearing and the bolts from the connecting rod.

The care that was taken to provide adequate and suitable lubrication for the chain and to protect it from dust and dirt has proved well worth while. The drive has been running for several years and the maintenance has been much less than with the engine in operation.

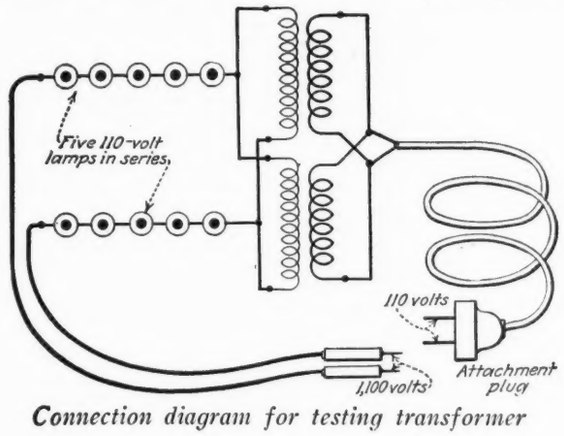
New York City. C. L. ALLISON.

High-Voltage Testing Set Made From Old Transformer

WHEN testing motors, designed for 440 volts and above, for grounds, the usual 110-volt test circuit is not very reliable. To obtain a more thorough test, I have made a testing equipment from an old one-kva. transformer that happened to be serving no good purpose in the shop. The transformer had a voltage rating of 2,200 to 220 and 110 volts.

As the motors to be tested were for 440 volts, it was considered that 1,100 volts would be sufficient. To obtain this, the two high-voltage windings of the transformer were connected in parallel as in the figure. The low-voltage windings were also connected in parallel and to an attachment plug so that the transformer might be plugged into any convenient 110-volt outlet.

To prevent blowing the fuses in case the 1,100-volt leads are connected to a dead ground, five 110-volt lamps are connected in series with each lead as shown. The test leads from the lamps are made of heavily insulated flexible wire with a short piece of rubber hose taped at the ends of the leads, so that they can be safely



Connection diagram for testing transformer

handled. A solid copper test point is soldered to each lead. To make the unit as compact as possible, the lamps are mounted on a small panel and attached to the back of the transformer.

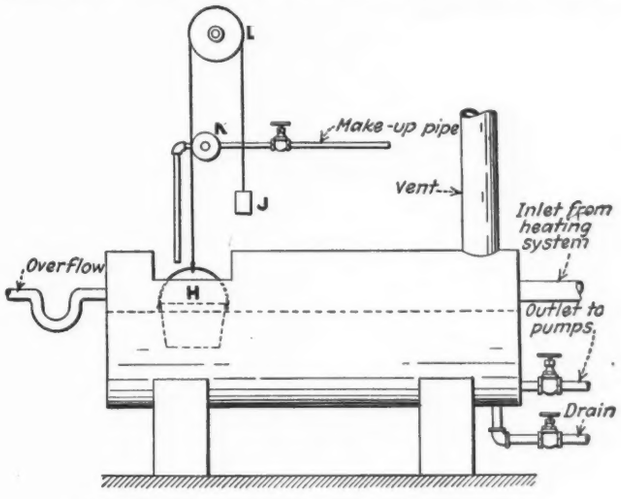
As long as the insulation does not break down when making the ground test, it is subjected to 1,100 volts, which is sufficiently high to break down any weak spots in the insulation that would be likely to give trouble on 440 volts. This testing equipment has been found to work satisfactorily and has detected many weak spots that would not have been found with the usual 110-volt test.

CHARLES A. ARMSTRONG.

Philadelphia, Pa.

Maintaining Water Level in Receiving Tank

IN OUR condensation receiving tank the float controlling the make-up water valve required so much attention that we devised the control apparatus, shown in the figure to relieve the trouble. As the drawing indicates, this equipment consists of a copper bucket *H*, hung where it will always be kept full of water, a small disk with two grooves in its face bolted to the handwheel of the make-up water valve *K*, the pulley *L* and the counterweight *J*. A chain leading from the balance weight passes over the pulley down to and around disk *K* and is



Method of controlling makeup water valve

attached to one of the grooves. The chain attached to the bucket passes around the other groove and is likewise attached to it.

When the water level in the receiving tank lowers, the bucket drops with it, opens the valve to admit more water into the tank and raises the counterweight. As the water level in the tank rises, weight *J*, which is about one-half that of the bucket filled with water, raises the bucket, closes the valve, thus admitting less water into the tank until the valve is fully closed. After installing this regulator it was surprising how little the water level varied.

Elgin, Ill. W. L. PARKER.

Water Lines Easily Traced With Aniline Dye

URANINE, an aniline dye, has been employed in following the sources of subterranean waters. It has been used successfully by me as an aid in tracing pipe lines in the plant yards where water from different sources was in use. Perhaps there are many power men to whom a dye of this nature could be of valuable service, particularly as it is inexpensive and easily obtained from almost any dyehouse.

One-half ounce of this dye is sufficient to color 10,000 gal. of water an easily visible yellowish green with a decided green fluorescence, while solutions as dilute as one part in a hundred million show unmistakable coloring when compared with standard water solutions.

It should be noted that the quantities of coloring matter used are so small that injury to boilers or other machinery requiring the water is impossible.

Arlington, N. J. RAYMOND L. DREW.

As the Other Fellow Sees It

WHERE THE MAN WHO AGREES OR DISAGREES WITH AUTHORS OR EDITORS HAS A CHANCE TO SPEAK UP

American versus European Diesel Engines

In your issue of Aug. 28, I notice a statement that Columbia University has purchased two Diesel engines in Germany with the explanation that better engines of this kind are made there than in the United States. I doubt the truth of this claim. I know a European engineer who has been employed by Burmeister and Wain and other Continental works where Diesel engines are made, as well as in similar works here, and he says that our facilities are fully equal to European, that our foundry work is better, and our machine and hand work are not surpassed by anything in Europe.

As for economy, have any engines in Europe surpassed the Shipping Board engines that have been recently installed, as shown by the tests of thirty days and nights without stopping? If they have I have not heard of it.

Consulting Engineer, F. W. DEAN.
Boston, Mass.

* * * *

Storing Coal

I disagree with some of the statements made by Messrs. A. A. Potter and H. L. Solberg in their article "How to Store Coal" in *Power,* August 28th.

In the first paragraph they say store only lump coal with no sizes under 1½ inch. For over thirty years I have been building coal storage plants and for the last fifteen have confined myself to the storage and handling of coal for power and gas houses. For power houses I am not called upon to store lump coal. It is either run-of-mine or crushed, usually the latter.

I do not believe nor do I think many believe that fines must be kept out of dump coal. It is neither practical nor necessary. To avoid or reduce the tendency of spontaneous combustion, air must be excluded. Confined pockets of air and circulation are both dangerous. Air circulation sufficient to ventilate and cool the coal is theoretically correct, but practically impossible.

The practical solution is to exclude air by having sufficient fines in the mass and compacting the coal in layers during storage. This can be done with a caterpillar tractor, or by using a cable drag scraper for storage.

Second Item: Avoid coal subject to spontaneous ignition. This concerns the mine owner and the purchasing agent and they are not easily controlled. The system installed for storage should be able to store any kind of coal with the least possible danger and with facility to dig out the ignited coal.

Third Item: Store on well drained, level and unventilated ground. The first and last requirements are essential. The second is not necessary with a cable drag scraper system.

Fourth Item: Avoid all sources of heat such as steam pipes; coal piled in warm weather will fire more easily than if stored in winter. Foreign material such as wood, rags, etc., is dangerous. I agree with all of this except possibly the summer storage.

Fifth Item: Thermometer in pipes to watch temperature. This may be worth while and is sometimes done. It is not common practice and can be dangerous because air can enter around the pipes.

Sixth Item: Under-water storage to prevent fires. I think this unnecessary with proper storage system. The wet, fine coal is an expensive nuisance, especially at powdered coal plants. Fine coal holds considerable water and it is expensive and troublesome to evaporate water.

After all the engineer must solve his problem practically and economically. I do not think lump coal free of fines is a practical fact even though it is screened at the storage plant. If it could be screened and did not disintegrate in handling into storage how would the fines be stored? Perhaps 80 per cent is under 1½ inch. The average stoker works better with coal finer than 1½ inch and with all fines below the given maximum lump. The average pulverizer is not called upon to handle coal 1½ inch and larger without fines. R. H. BEAUMONT.
Philadelphia, Pa.

* * * *

Correction of Steam-Flow Meter for Change in Size of Orifice

THE author of the article "Correction of the Steam-Flow Meter for Change in Size of Orifice," published in the Aug. 28 issue, not only chose an extremely round-about method to remedy a simple condition, but also advocated a solution which would have multiplied rather than corrected the faults of the meter in question. When a flow meter, or for that matter any instrument or device, needs correction, the logical procedure to adopt is to seek out and eliminate the exact conditions that cause the trouble, and not introduce supplementary appliances that indirectly rectify the faults.

When a flow meter is used with an orifice of a size different from that stamped on the meter data plate, the new capacity and factors for the instrument can be calculated without much difficulty from standard formulas available on fluid flow. It is seldom that a flow meter is used without knowledge of the orifice size. Generally a tag is attached to the orifice plate showing the diameter of the orifice hole, and if not, the plate can be removed from between the flanges in order to measure the hole.

Should it be known that inaccurate results are being obtained even after the factors corresponding to the proper orifice have been checked and the recorder inspected, there are other points to consider, such as condition of the differential pressure piping, effect of valves and fittings in the main pipe near the orifice, and possibility of pulsations in the steam.

Checking the steam flow meter against the venturi water meter proves little, if anything at all, because the latter may be out of adjustment itself. The measured steam will not equal the water input, for the unknown amount of blow-off water and steam used for soot blowers must be considered. Also, attempts to compare the instantaneous readings of the steam meter and venturi

meter would be misleading because of the improbability of steam being generated at the same rate that water is pumped to the boilers. If the boiler feed pumps are of the reciprocating type and no means are employed to dampen out the pulsations imparted to the water by the pistons, the venturi meter readings will be in considerable error, generally in a plus direction, and great enough so as easily to cause the discrepancy of 25 per cent mentioned in Mr. Weber's article. Leakage through the blow-off valves would aggravate this discrepancy. In addition, when boiler compounds or chemicals are used to treat the feed water, a coating on the inside walls of the venturi tube will so alter the ratio of throat diameter to inlet diameter that the readings of the venturi recorder will be attended by appreciable inaccuracy. Of course, in some cases boiler compound may not be found adhering to the walls of the venturi tube. Also, centrifugal pumps may be used, or a means employed to smooth out the pulsations from the reciprocating units. However, these points illustrate how improper it is to check one meter against another, at least, not until one of the instruments has been carefully calibrated and either volumetric or weighed water tests have been made to determine the accuracy.

When a flow meter has been properly installed and inspected, the results obtained from it should be within 2 per cent of absolute accuracy, and under most conditions it is not difficult to secure and maintain such results.

O. H. WOOLFORD,
Philadelphia, Pa. Cochrane Corporation.

* * * *

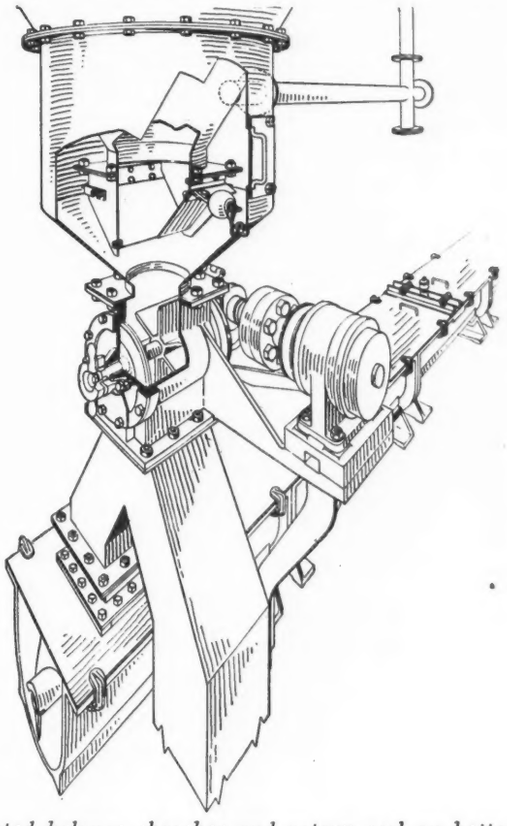
Fan on Collector Discharge Cuts Pulverizing Costs

I READ with interest in the July 31 issue John Anderson's description of his coal milling system in which he places the exhauster on the return-air circuit between the cyclone and the mill.

In the editorial in the same issue referring to Mr. Anderson's article mention is made of a paper presented by me before the Institution of Electrical Engineers of London, and the fact that this type of milling system is described therein.

As a matter of information, a still earlier description of this system by the writer is contained in the Prime Movers Committee report in the Pulverized-Fuel Section for the year 1927. This appears on page 1340 of the bound volume.

We now have many plants in operation with the exhauster placed as described and all of them are working satisfactorily. The vital point in the success of the arrangement, however, was not brought out in Mr. Anderson's description but is described in the N.E.L.A. report. In the arrangement shown by Mr. Anderson, the cyclone discharges its pulverized product direct to the transport pump which, it is presumed, thoroughly seals the outlet of the cyclone and prevents any upward flow of air at this point. For the normal installation in which the cyclone discharges either to a screw conveyor or direct into a storage bin, it is necessary to effectively seal the bottom of the cyclone. The device which we have adopted for this purpose is as shown on the accompanying illustration. What we term a balance chamber is provided on the bottom of the cyclone into which the pulverized fuel is discharged through a weighted flap valve and from which the coal is discharged through a motor-driven rotary seal. With even the best type of construction, air will find its way up through the rotary seal and such leakage will increase as the rubbing surfaces become worn. To prevent this air from passing up through the cyclone, the balance chamber is vented into the return air pipe. This vent provides a tendency for the air to pass downwards out of the cyclone rather than the reverse, and, hence, avoids all possibility of interfering with the separating function of the cyclone.



Vented balance chamber and rotary seal on bottom of cyclone

It is this arrangement which has made all the difference between success and failure of the arrangement. It is the absence of such an arrangement that has resulted in the failure of previous attempts. F. H. ROSENCRANTS.

London, England.

* * * *

Return-Tubular Boilers

THE "Defense of the Return-Tubular Boiler" by F. W. Dean, in the July 10 issue was very interesting, although I hardly agree with Mr. Dean as to the maximum size from a safety standpoint. It seems to me that 78 in. ought to be about the maximum diameter. When one recalls some of the explosions of the past, it is not to be denied that there is a hazard in confining too much steam and water in a single space.

Except for its limitations as to size, the return-tubular boiler is a highly successful type of steam producer and is well adapted to the needs of a large percentage of heating and power plants.

One advantage of the front-end blowoff proposed by Mr. Dean would be that inasmuch as the loose scale generally accumulates around the blowoff opening, this scale would be easily removed when the front man-hole plate was knocked in. CHAS. P. WHITTY.

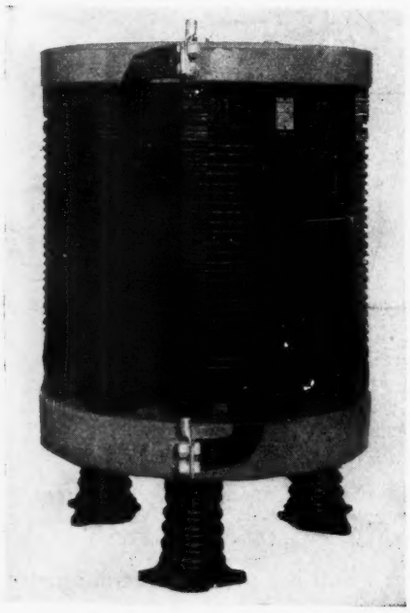
New Orleans, La.

What's New in Plant Equipment

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING TRANSMITTING AND APPLYING THE POWER SERVICES

Dry-Type Current-Limiting Reactor

CURRENT-limiting reactors are coils having high inductance that limit the amount of current in a short circuit. The prevention of heavy currents in short circuits will prevent severe mechanical stresses in connected apparatus, and avoid serious drops of voltage in feeders. A



Reactor is wound with insulated cable

new dry-type current-limiting reactor, shown in the figure, has recently been announced by the Westinghouse Electric and Manufacturing Company.

The reactor consists of a winding of insulated cable wound around a hollow concrete cylinder. A concrete disk, having ventilation openings, is fastened to each end of the cylinder by studs screwed into alloy inserts. The structure is mounted on post-type porcelain insulated feet.

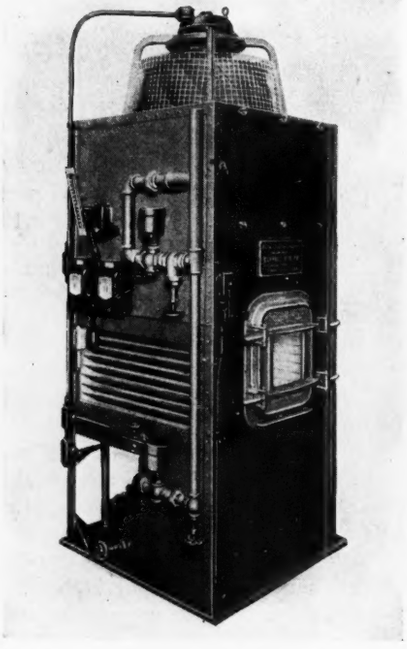
The windings consist of disk-shaped layers of cable, wound radially so that the electrical stress between layers is low. The use of large cross-section copper results in a reactor of low heat losses and low operating temperatures.

The cable insulation provides protection against short-circuited turns. It possesses a high dielectric strength and is heat and fire resisting. Symmetrical spacing of all cables insures an equal division of the load between them and eliminates circulating currents. The spacing of the end turns is such as to give additional insulation at that point. The turns and layers of the winding are separated by vertical and radial spacers.

One end of all cables of the winding is connected to a terminal at the top of the reactor, while the other ends are connected to a terminal at the bottom of the coil, all connections being welded.

Unit Humidifier

THE new Type I humidifier, illustrated, recently brought out by the Clarage Fan Company, Kalamazoo, Mich., offers in one unit a heater and humidifier, or if provided with a cold-water connection, a dehumidifier, if desired, which is adapted to the air conditioning of any small space or single room. A battery of the units for conditioning an entire factory



Unit is completely equipped for automatic operation and control

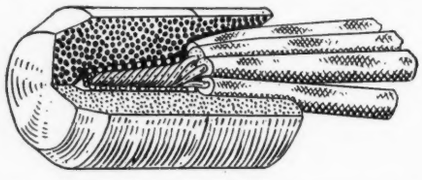
building has the advantage that plant changes may easily be made, as there is no duct system required.

Conditioned air is discharged from the top of the unit in all horizontal directions by a centrifugal-type fan, designed with a self-limiting horsepower characteristic, to prevent overloading the motor.

The units are built in two types and eight sizes, capable of handling from 1,200 to 5,500 cu.ft. per min. They are shipped completely assembled, with all necessary auxiliaries for operation and automatic control.

Solderless and Tapeless Wire Connector

TO AVOID the common practice of joining wires by twisting, soldering and taping them to make up the joint, the Ideal Commutator



Cross-section through wire connector

Dresser Company, Sycamore, Ill., has placed on the market a new type of mechanical connector. A cross-section of this connector is shown in the figure. The body of the connector is made of molded insulating material. At one end is a receptacle for the ends of the wires, as shown in the figure.

In the receptacle is a copper-coated tapered steel spring with a current-carrying capacity equal to the wires to be joined. When making up the joint, the connector is placed over the ends of the wires and twisted into space much like a nut is screwed on a bolt. In this operation the copper-covered spring threads in with the wires and makes a positive contact, acting as a current-carrying sleeve.

These connectors are made in two sizes. One is for joining groups of wires ranging in size from two No. 18 to four No. 14. The other size will join groups ranging from four No. 14 to three No. 10. The wires may be either solid or stranded. The connectors are so small that they will easily fit into standard-outlet boxes.

Non-Pulsating Valve Motion for Duplex Pumps

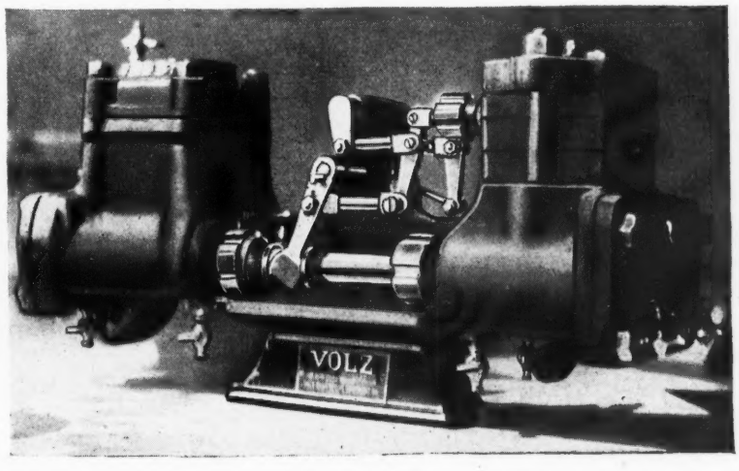
WITH a view to reducing or overcoming the pulsation in duplex pumps and thereby obtain a more uniform flow at the discharge, the Volz Engineering Corporation, Long Beach, Calif., has developed the valve gear illustrated.

The principle involved is that of overlapping the piston travel at the beginnings and ends of their strokes so that one at full speed or both at half speed are always in motion and each starts on its return immediately without any wait between strokes.

When piston travel overlaps, steam is equally divided between them and both move at half speed. When the right-hand piston finishes its stroke, its valve port closes and all steam enters the left-hand cylinder, producing full speed until the lap position arrives again near the end of the stroke.

Referring to the illustration, it will be seen that the valve motion has two more members on each side than the ordinary duplex motion, namely, a floating lever and link. Each valve rod is connected by linkage to both pistons, so that while the movement of each valve is actuated by both pistons, the opposite piston causes most of the throw and maintains "step."

The piston on the same side also acts through a link to the floating lever, causing the overlap in piston travel, one piston starting as the other nears the finish of its stroke.



Typical installation of valve gear on duplex pump

The total port area open at any one time substantially equals one port fully opened. When one piston is at the end of its stroke the other is traveling at full speed, and when one piston is decreasing in speed the other is increasing so that the total displacement speed is the same.

The overlapping piston motion fully opens the inlet port of one piston at the intermediate position of its stroke while maintaining the inlet port of both pistons closed, and opens the inlet ports of both pistons at the ends of their strokes in a cumulative amount equal to the full opening of one port.

Among the claims made by the manufacturer for this valve gear are reduced steam consumption, increased discharge capacity and lower maintenance when used on any standard duplex pump.

Liquid Meters That Measure by Actual Displacement

A TYPE of liquid meter that measures by actual displacement is being put out by S. F. Bowser & Company, Fort Wayne, Ind.

The meter shown in section in Fig. 2, contains five cylinders *A*, each fitted with a piston *B*, the lower ends of which are fixed to a wobble plate *C*. As the liquid flows into parts of the cylinders, the liquid in the other cylinders is being discharged through the rotary valve *D*, the pressure causing the wobble plate to operate, which in turn operates the recording mechanism mounted on the top of the meter.

The meter is made in five sizes. No. 1 has a $\frac{3}{4}$-in. pipe connection, a capacity of 10 gal. per min. and is designed to operate against a head pressure of 125 lb. The corresponding figures for the other sizes are: No. 2, $1\frac{1}{4}$-in. connection, 20 gal., 50 lb.; No. 3, $1\frac{1}{2}$-in. connection, 40 gal., 50 lb.; No. 4, 2-in. connection, 80 gal., 50 lb.; and No. 5, 3-in. connection,

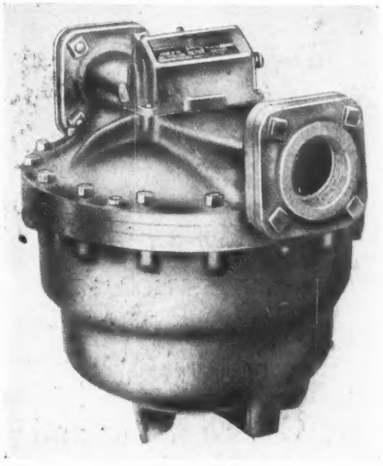


Fig. 1—Xacto meter

200 gal., 50 lb. The meter is fitted with an angular face dial arranged for easy reading. The No. 1 meter is equipped with continuous counter with one-tenth-gallon wheels recording up to 100,000 gal. The No. 2, 3 and 4 are equipped with continuous

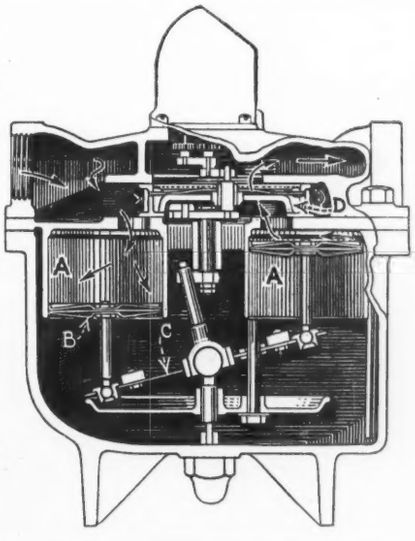
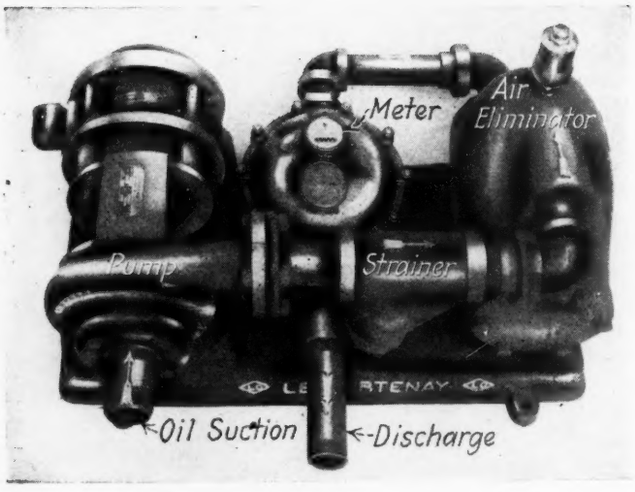


Fig. 2—Cross-section of meter

counters recording up to 100,000 gal. and then repeating. The No. 5 is equipped with continuous counters recording up to 1,000,000 gallons.

The body of the meter is of cast iron and the interior parts are of material best suited to the liquids to be handled. A pipe line strainer and air release, for use with the meter, are also available, the air release being necessary where a pump is used to handle the liquids.



Pumping and metering unit equipped with strainer and air eliminator

Oil Pumping and Metering Set

THE pumping and metering set illustrated, designed for unloading and metering of any liquids handled in quantity, is a recent development of the Lecourtenay Company, Ferry and Main Sts., Newark, N. J.

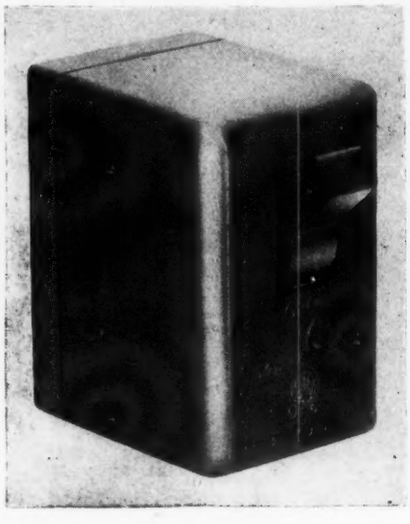
The unit consists of a centrifugal pump, strainer, air eliminator and meter, the parts being grouped to form a compact unit. The suction and discharge are brought out on one side of the unit from which point the connections can be made to suit practically any desired arrangement. The pump has a capacity of 100 gal. per min. against a head of 20 ft. The pump discharge is connected through a strainer and air eliminator to the meter, as indicated. The automatic vent on the air eliminator is arranged to be piped away to save the gas or to prevent the forming of an explosive mixture. The weight of the unit is approximately 900 pounds.

Small Automatic Circuit Breaker

AN AUTOMATIC circuit breaker, shown in the figure, designed for use on 125-volt alternating or direct current, with ratings of 6, 10 and 15 amperes, is now being manufactured by the merchandise department of the General Electric Company, at Bridgeport, Conn. This device was developed to control and protect branch lighting circuits, as well as small motor-driven apparatus, and differs from similar breakers in that it combines the positive action of the electromagnet with the time lag of the thermo-metallic element, but does not require the thermal element to do any mechanical work. The breaker operates single pole with a double break on the contact.

The opening of the silver contact points due to heating of the thermal element on overload causes all of the current to pass through the magnet, and trips the breaker instantly. The time necessary to heat the element under the various degrees of overload constitutes the lag which is comparable to the action of a fuse, permitting the momentary inrush of current but protecting against a continued overload.

As an appliance switch it can be mounted in any position, has no exposed metal, functions equally well on alternating or direct current, and will withstand severe vibration without opening.

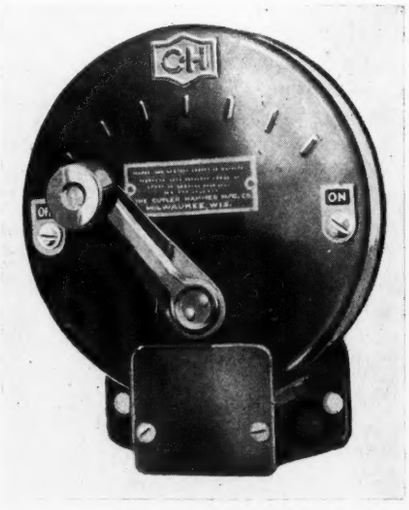


Circuit breaker to protect small-motor and lighting circuits

The sliding contacts tend to maintain clean surfaces. The floating contact spreader assures even, level bearing and equal pressure. The toggle handle movement is easy to operate, and always indicates by its position whether the circuit is open or closed, the handle pointing upward when the breaker is closed and downward when it is open.

A Regulating Rheostat for General Service

NEATER appearance and simplicity of installing are the features of a new direct-current regulating rheostat announced by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. This new rheostat can be used to control the speed of fractional-horsepower motors driving small blowers, fans, buffers and similar apparatus; it can be used as a dimmer on lighting circuits, or it can be used as an electric heater regulator.



Rheostat may be mounted directly on the machine

The device, as shown in the figure, is of the circular-plate type, completely enclosed. It is small in size and permits mounting directly on machines or in any out-of-the-way place. The standard rheostat is furnished for conduit wiring, but if open wiring is to be used a porcelain bushing is quickly added.

The mechanism consists essentially of a cement imbedded resistance unit, with brass contact buttons protruding through the cement, and a contact arm which moves over the buttons, varying the resistance. An enclosing case with an outside operating lever protects the unit and prevents accidental contact with live parts.

Mining Properties Reduce Power Costs with
4,500-kw. Diesel Plant

By Geo. J. Stein

Chief Engineer, Commerce Mining & Royalty Company, Miami, Oklahoma

A 4,500-kw. central Diesel plant, modern to the last detail, supplies dependable power to a great group of mining properties under one management. The article is based on a paper presented on September 10 at the Commerce Mining and Royalty Congress in Los Angeles.

ONE of the largest producers of lead and zinc is the Commerce Mining & Royalty Company of Miami, Oklahoma, which started operations in 1907. From a small beginning the company has grown to one which has larger ore reserves than any other company operating in this field. It is estimated that its present known reserves would permit a weekly production of 1,000 tons for the next thirty-five years.

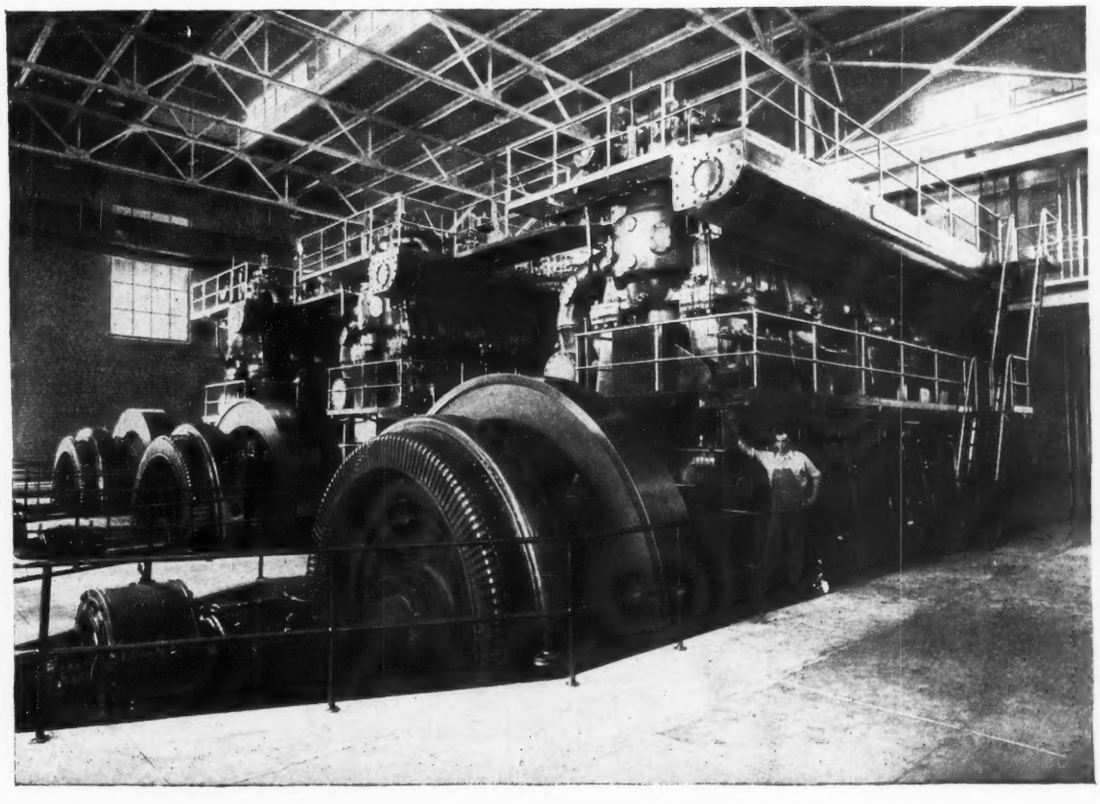
The building of a central plant for supplying compressed air for the various mines and later the central Diesel power plant, are examples of the foresight and aggressive policies of this company. A compressor station built in 1925 supplies air through twelve miles of pipe line. The success of this plant was a factor in the later installation of a central power plant.

In 1926, a survey was made to determine the advisability of installing equipment to supply the power needs of the company. It was believed that with the great amount of power used, and with the assurance that the ore reserves would permit of at least thirty-five years' mining operations, power could be produced at a substantial saving over the existing arrangements. A number of isolated plants were maintained aggregating about 500 horsepower in gas engines, all power beyond this capacity being purchased.

As a result of this survey, also an investigation of the type of power unit most suitable for the conditions, three 2,250 hp. Nordberg Diesel engines were selected, each driving a 1,500 kw., 2,300-volt, 3-phase, 25-cycle generator with 40-kw. direct-connected exciter. The engines run at 125 r.p.m.

The decision to turn to Diesel power was influenced to some extent by the performance of three other Diesel plants, which had been operating satisfactorily in mining service. This new Diesel plant with its 6,750 hp., is the fifth largest in North and South America.

The plant is located just west of Cardin at a point about central with respect to the various properties and the present known ore reserves. This location was in reality determined in 1925, when the compressor plant was built on this site. The engines supply power for eighteen mines and mills, the central air plant, the Northeast Oklahoma Railway, a subsidiary road with 53 miles of track, and standby service to the City of Miami. Construction on this plant was



Present installation consists of three 1,500-kw. units, with space for a fourth unit

started in August, 1926, and it was placed in regular operation in August of the following year.

All the details incident to the design, layout and construction were handled by the engineering department of the company, under the direction of the chief engineer in conjunction with engineers of the Nordberg Mfg. Co.

In addition to building the power plant, about 35 miles of primary and secondary transmission lines had to be built, also sub-stations constructed at the mines and along the railway. The primary lines carry 33,000 volts and the secondary 2,300. The step-up transformers and outdoor switch station are located in the power-house yard and are of sufficient capacity to take care of future expansion, in case another power unit is installed. Transmission lines also are liberally proportioned, eliminating objectionable voltage drop and permitting a material increase in load should mining operations be later increased. The longest line going to any mining property is about ten and one-half miles, while about fifteen miles of line are required to reach the farthest railway substation.

Layout of Power House

The building housing the engines is 80 x 120 ft. inside with a 45-ft. headroom beneath the roof trusses. The original installation consisted of three units, but there is ample space left for a future unit. The building is of steel frame construction with Lock Bond tile walls. In the basement are located the water circulating pumps, centrifuge, fuel-oil filters, spare parts storage, lockers and change room for employees. The basement headroom is 10 ft.

The switchboard is located on the engine-room floor. The office for the plant engineer is on an elevated platform in the southeast corner. The engine room proper is served by a 20-ton, 60-ft.-span Harnischfeger traveling crane with cab control.

Going into the engine room, one is impressed by its orderly and well kept appearance. The grey enameled floor is an example of cleanliness. The basement floors are free from water and oil and present a contrast to the ordinary Diesel plant where no provision has been made to confine such drips.

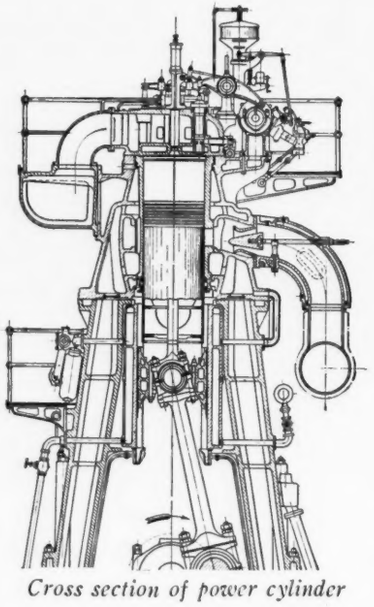
Adjacent to the engine room at the north is the motor-service room, under the floor of which is the hot well. Beyond the motor-service room is the central compressor plant, in which are installed three 2,200-cu.ft. two-stage Worthington Compressors, driven by 364-hp. Westinghouse synchronous motors. The water for compressor cooling is secured from the spray pond.

The exhaust mufflers, together with the air-filter chambers, are built of reinforced concrete and located outside the west wall. Each is 10 ft. wide, 14 ft. 6 in. long and 18 ft. deep, with a baffle wall down the center, all the walls being 9 in. thick. The exhaust and suction pipes have a diameter of 28 in., and are made of welded steel, the former extending to the power house roof. The exhaust pipe is 28 ft. high and surmounted by a hooded screen.

Each air filter chamber is equipped with 27 standard Reed 20-in.-square filter sections. After ten months of operation, six sections were removed from each chamber for cleaning. These had accumulated the major portion of the dirt. It is the plan to clean but a few sections at similar intervals.

Fuel Handling System

Adequate and convenient fuel oil storage is provided. Heavy fuel oil is stored in two 10,000-barrel steel tanks and light oil in a 15,000-gal. tank, all located above ground. This provides for about nine months' operation with the average load so far carried. With this amount of storage, it is possible to purchase fuel in quantity under favorable market conditions. To guard against the possibility of a disastrous tank fire, caused by lightning or other sources, a Foamite System is being installed.



Cross section of power cylinder

Oil is brought into the plant yard over a switch leading off the company's railroad. A 4-in. unloading rack permits three cars being unloaded at a time, which can be accomplished in about four hours. In the unloading pump house, a building of fireproof construction, is a motor-driven Blackmer Pump. The piping is so arranged that one pump handles either heavy or light oil.

Since the plant was placed in service, the north tank has been used as a regular source of supply, the south tank for storage only. Each tank has a 250-sq.ft. heating coil of 4-in. pipe, connected to the discharge line from the hot well to the spray pond. The hot-water pipe and fuel oil line are enclosed in the same insulation. A small vertical boiler is placed in the yard to provide heating for tank cars in extremely cold weather.

The transfer pump house is similar in size and construction to the unloading house.

Fuel oil storage for all three engines is carried in two daily fuel supply tanks located on the west wall just below the roof. The piping is so arranged that either tank will supply any two engines. Each tank has two compartments, one for heavy and the other for light fuel. Just below the fuel tanks are the fuel-oil filters to which the oil flows by gravity, and from the filters passes on to the fuel pumps.

The supply tanks and filters are provided with heating coils, hot water for this purpose being taken from the jackets of the exhaust pipe elbows. In order to secure a higher water temperature than is obtainable from the exhaust, this is supplied from a coil of 3-in. pipe placed in the exhaust pipe. Normally the temperature of the water is regulated to keep the fuel oil temperature at about 120 deg. F. Daily supply tanks and filters are of Nordberg design. The engines operate on heavy fuel oil of approximately 14-16 deg. Baumé, while the light fuel oil is 32-26.

Lubrication System

With the exception of the power and compressor cylinders, lubrication to all parts of the engine is supplied from a gravity system. After passing through the engine, the oil drains into a Nordberg gravity type filter placed in the basement. A gear type pump, chain driven from the engine shaft, transfers the filtered oil to the three overhead lubricating oil-storage tanks located on the same level as the fuel oil filters. It is then ready for recirculation. These storage tanks are equipped with cooling coils, permitting a uniform oil temperature to be maintained.

All the cooling water going to each engine is brought to these coils through a 6-in. line, but a bypass at the engine-room floor allows all, or a portion of water to be bypassed, depending upon the amount of oil cooling required. During the winter it is not necessary to cool the oil.

In addition to purifying the oil by gravity filtration, a No. 6 Sharples centrifuge is used. The original charge of oil is still being used after nine months of service, the oil being clear and giving satisfactory lubrication.

The centrifuge is located in the basement and is kept in constant service, it being customary to use it on the engine that is on the twenty-four-hour run. The drain piping of each engine is so arranged that the oil going to any filter can be sent through the centrifuge instead.

Cooling Water Supply

One of the most important requirements for successful operation of any Diesel engine plant is an adequate supply of suitable cooling water, together with a properly designed cooling system. This detail has been carefully worked out in the Cardin plant. The source of supply is obtained from a nearby company mine and fortunately carries very little scale forming material. Instead of depositing scale, as is the case in most Diesel plants, the water seems to have a slight corrosive action, which is being corrected by treating the water.

After passing through the engines, the water drains into a 12-in. header, which empties into the hot well.

Pumping equipment for the water-cooling system is located in the north end of the basement. Two pumps are provided for discharging from the hot well to the spray pond, but only one is normally required, the other serving as an emergency. American-Marsh centrifugal pumps are used having a capacity of 600 gal. per min. at 75 ft. head. These are direct connected to 20-hp. Westinghouse motors running at 1,450 r.p.m. The spray pond discharge line terminates in 24 spray nozzles.

From this line a connection is made permitting a portion of this hot water to circulate through the heating coils in the large fuel oil storage tanks. This line terminates in eight spray nozzles.

From the spray pond, a 10-in. intake line leads to the basement, where there are three American-Marsh centrifugal cold-water pumps of 600 gal. per min. capacity at 175 ft. head.

One pump is ordinarily used except on hot days when two are required. The arrangement of the piping also permits any one of these larger pumps being used for discharging from the hot well to the spray pond, taking the place of the smaller hot-water pumps should they fail. These three pumps discharge into a 12-in. cold-water line at a pressure of between 70 and 75 lb. This line, from which the engine cooling water connections are taken, is also connected to the 100,000 gal. overhead steel tank, located about 100 ft. above the ground level. By draining roof water into the spray pond, soft water is obtained for a portion of the makeup.

It is a remote possibility that in a plant of this size and with the number of units installed, the air supply in the starting bottles will be entirely exhausted and starting of the engines thereby prevented. However, to guard against such an occurrence, an auxiliary compressor driven by a gasoline engine, has been installed in the basement.

For eight hours during the day period the plant is carrying practically full load. In fact, there were times late in 1927 when it was necessary to transfer part of the mill load from the day to night shift. For the remainder of the time the load drops as low as 400 kw. This results in an unfavorable load factor, slightly more than 30 per cent.

In addition, the power factor is low, this being 80 per cent from 8 a.m. to 4 p.m., 61 per cent from 4 p.m. to 12 p.m. and 53 per cent from 12 p.m. to 8 a.m.

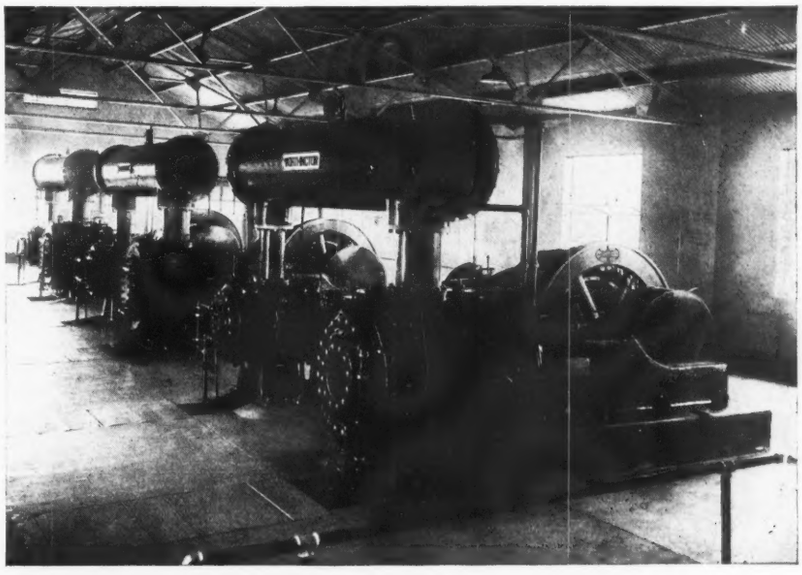
Even with the plant operating in this manner, it will pay for itself in six years, based on the savings over purchased current of 1.75c. per kilowatt-hour.

The operating force consists of a plant engineer, three shift engineers working eight hours each and an oiler on each shift. During the eight hour heavy load period, three engines are kept in service, but during the period from 5 p.m. to 6 a.m. only one is required.

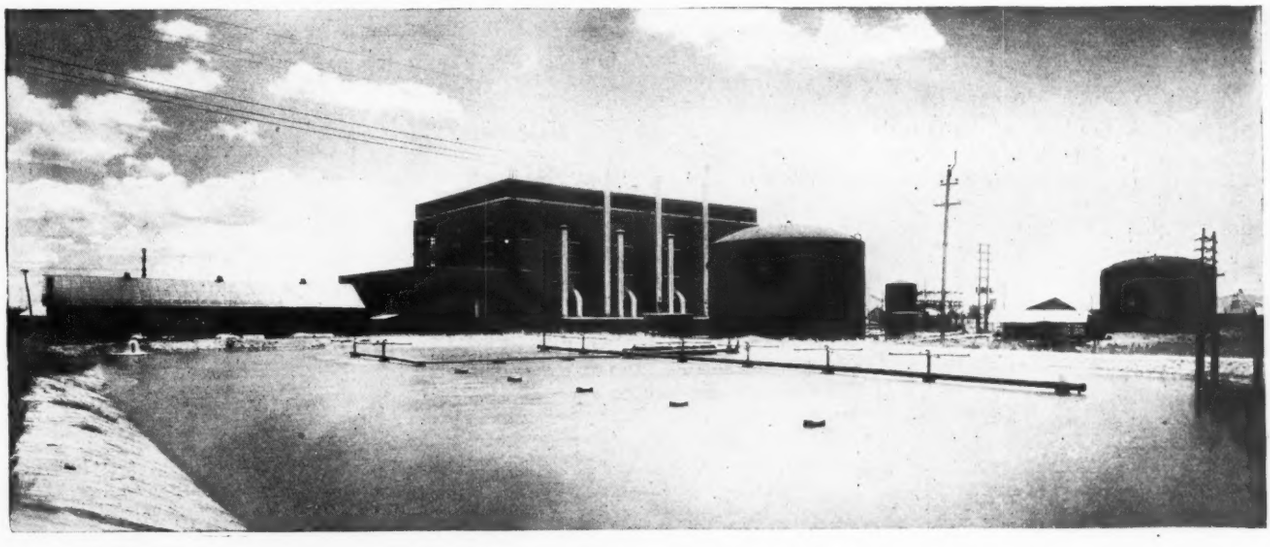
Since the Diesel plant has been in operation, the quality of service received at the various properties is considerably better than formerly. Low voltage has been eliminated, and interruptions to service are a rarity. At no time has the plant ever been shut down completely, the most serious occurrence being an engine down for a few moments necessitating taking current off of some of the lines for a short period.

Considering the fact that an operating force had to be developed and trained, and also that the engines were fully loaded during the day period and without a spare unit available, the service has been remarkably free from shut downs.

The four-cylinder Nordberg Diesel engines, like all other Nordberg designs, are of two-cycle type. They operate on the full Diesel principle; that is, fuel is injected by means of compressed air. With a bore of 28 in. and a stroke of 44 in., they are rated at 550 hp. per cylinder.



Diesel-generated current drives compressors in central compressed-air plant

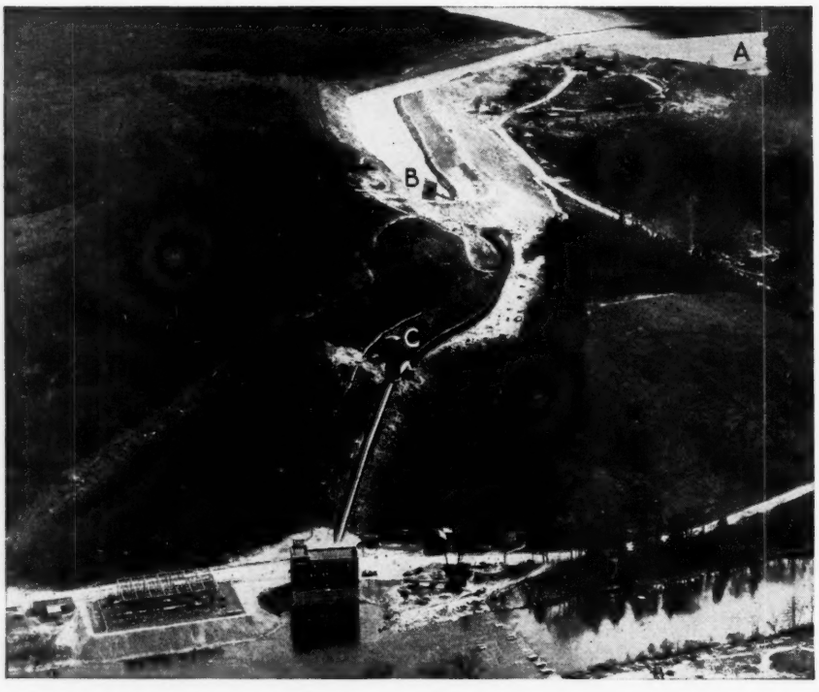


General view showing Diesel plant, spray pond and oil-storage tanks

Events and Men in Power's Field

THE EDITORS WILL WELCOME THE CO-OPERATION OF READERS IN REPORTING INTERESTING HAPPENINGS, PERSONAL OR OTHERWISE

The First Hydro-Electric Plant In America to Operate on Pumped Water



This picture shows an airplane view of the Rocky River hydro-electric project, of the Connecticut Light and Power Company, on the Housatonic River. The plant contains one 33,000-hp. vertical shaft generating unit and two 112,500-gal. per min. pumps, when operating against a head of 240-ft. The pumps are driven by 8,100-hp. motors. Water is pumped from the Housatonic River into a reservoir on the Rocky River. In the picture the main dam at the lower end of the reservoir can be seen at A, the intake to the pipe line is at B, the surge tank is at C, from where the penstock leads down to the power house on the Housatonic River. The pumps have been in operation for a number of months and load tests are now being made on the generating unit.

Features of Detroit Edison's New Plant

In the September issue of the Detroit Edison Syncroscope, P. W. Thompson, chief assistant engineer of power plans, describes many of the main design features of the new power house that company is erecting, known as Delray power house No. 3. The capacity to be installed in the unit now being constructed is 100,000 kw., while provision is being made for an ultimate capacity of 300,000, or 350,000 kw.

Two tubrine-generators each rated at 50,000 kw. will be installed in the first section. These machines will be essentially duplicates of those now installed at Trenton Channel, except that steam for feed water heating will be extracted from four stages instead of at three stages as at present. The generating units are to be supported on reinforced concrete foundations.

Only five boilers will be installed in the first section, although the building has been designed to accommodate six. The Type-W-Sterling boiler, which has long been the standard in the Detroit Edison power house practice, has given way to a new design of bent-tube boilers, similar to that of the Sterling character. This boiler unit comprises in reality two distinct boilers. The upper or main boiler will have three upper drums and one lower drum. The superheater will be so located with respect to the main boiler that its headers are at the top and entirely outside the gas passes. The lower, or screen boiler, is so arranged as to surround the combustion chamber with water tubes on all four walls. This boiler will have one large steam drum which will be connected by tubes and pipe to front, rear and side wall headers. The circulation system of this screen boiler will be entirely independent of the main boiler, but the steam generated therein will be discharged to the front drum of the main boiler. Steam will be generated at approximately 400 lb. per sq.in. pressure, and 700 deg. F. total temperature.

Additional heating surface will be provided in an economizer and air preheater. The air preheater surface will be so proportioned as to heat the air supplied for combustion to approximately 350 deg. F. at maximum rating. The stokers will be single ended and designed to burn a maximum of 17 tons of coal per hour.

Essential auxiliaries will be driven by direct current motors, receiving energy from geared turbine-generator sets as at Trenton Channel. No switch house or main-control room is provided in the power house, but an addition to the Waterman substation is being made for a 24,000 volt bus, machine and trunk line switches and control, and the load on the units will be controlled from this station.

Activities of the Federal Power Commission

During the fiscal year ended June 30, the Federal Power Commission received eighty-seven applications for water power rights. This brings the total of all applications since the enactment of the water power act, to 910. Of the new applications 38 were for preliminary permits and 49 were for licenses. Only five of the 49 licenses, however, covered important projects. The remaining 44 were for transmission lines or minor parts of projects. In addition, however, seven holders of preliminary permits represent 1,925,000 hp. applied for major licenses. These applications for licenses covered a total of 925,000 hp. The 38 preliminary permits represent 1,925,000 hp., the estimated installed capacity.

At the close of the fiscal year 138 original cases were awaiting action, in addition to 23 other applications for license from permittees. Of that total 75 were in a suspended status for reasons beyond the control of the Commission. These cases include projects on the Colorado, Tennessee, Potomac and St. Lawrence Rivers, and cases in litigation in the courts or before the state commissions. This leaves a total of 86 cases on which the Commission could act as compared with 103 at the close of the preceding fiscal year. On June 30, 1928, there were in effect 337

licenses and 58 permits. Allowing for duplications 529 of the 910 projects were in an active status.

The Commission acted during the year on 33 applications, of which 25 were granted and 6 were rejected. One authorization was rescinded and one other was authorized as an amendment to an existing license.

Sixty-six cases during the fiscal year were assigned for field investigation. The Departments of War, Interior and Agriculture made reports on 68 projects and 57 additional ones were under investigation at the end of the year.

Seventy-one licenses and eleven permits were issued during the fiscal year. Ten permits expired and four were cancelled. Three were superceded by license and two additional ones were disposed of otherwise. Two major licenses and four minor ones were terminated. Of the 337 licenses outstanding 97 were for major projects and 240 for minor rights. The estimated installed capacity covered by licenses is 6,114,000 hp. and by permits 5,558,000 hp.

Eight declarations of intention were acted upon during the year and four are pending. Jurisdiction was taken in only two of the cases decided.

Ontario Paper Company Starts 300,000-hp. Development

Among the more important power development projects now under way in Eastern Canada is that of the Ontario Paper Company, Limited, on the Outardes River, in the province of Quebec, about 190 miles below the city of Quebec. There, in the heart of the province's least-known territory, men have planned for the turning of the wealth of the woods into newsprint, and for this purpose have started to harness the natural falls of the Outardes. An auxiliary power house has been erected to provide light and power for the works, and for the permanent quarters of the company's officials.

Where the little hamlet of Outardes Falls now stands, the power station, designed for an ultimate development of 300,000 horsepower, will be built. The station will be fed from the stored waters of the dam some three miles distant. The waters will be carried down for about three quarters of a mile through an open canal, and thereafter for the remainder of the distance, through a 16-foot penstock.

The dam, which will be 230 feet long will have a net head of 205 feet, and will serve an initial development of 40,000 horsepower, which will run to 100,000 horsepower when made into a complete unit. This damming of the river, at its fastest point, will back the water up to flood an area of some 1,000 acres. The main dam will span the river, while two smaller dams will deal with two natural depressions in the ground, that will become water courses when the work is completed, and will be controlled by sluice-gates.

The hydro-electric power developed at Outardes Falls will not be used there, but will be carried by transmission line across the neck of the Manicouagan peninsula, for more than 25 miles, to the site on English Bay chosen by the Ontario Paper Company for its new mill. The company has already spent about $1,000,000 in the Outardes area and expects to spend a total of $7,000,000.

Atlanta Power Conference of Importance to South

Means of fully utilizing the South's water-power resources to provide for the growing demands of both industry and agriculture will be one of the most important topics to come before the fourth meeting of the Southern Appalachian Power Conference in Atlanta on *Oct. 8, 9 and 10*, which, it is predicted may prove one of the most important industrial conferences ever held in the South. Some of the best qualified men in the country will lead the discussions, and it is expected that considerable headway will be gained toward solving the South's power problem.

The economic value of interconnecting power lines for efficient distribution of electricity throughout the South, the matter of power rates, power legislation, forestry conservation as an aid in the preservation of water powers and river surveys will be among the specific topics. Among those who are expected to take part are William E. Humphrey, chairman of the Federal Trade Commission; P. S. Arkwright, president of the National Electric Light Association; General Edgar Jadwin, chief of engineers, U.S.A.; Wilbur A. Nelson, state geologist of Virginia; Warren King of the United States Geological Survey, and N. M. Argabrite, vice-president of the American Gas & Electric Company.

The Southern Appalachian Power Conference is headed by Dr. Andrew M. Soule, president of the Georgia Agricultural College. L. O. Crosby, president of the Mississippi State Development Board, is vice-president; E. Y. Chapin, president of the American Trust & Banking Company of Chattanooga, is treasurer, and Wilbur A. Nelson, state geologist of Virginia, is secretary.

New Timken Steel and Tube Company Formed

Announcement has just been made by the Timken Roller Bearing Company of the incorporation of a new company, known as the Timken Steel and Tube Company, which will take over the manufacture and selling of Timken steel and tubing. The headquarters and mills are in Canton, Ohio, with sales offices in Chicago, Los Angeles, Detroit and New York. The officers are: H. H. Timken, chairman; M. T. Lothrop, president; J. W. Spray, vice-president; A. J. Sanford, vice-president in charge of sales; J. E. Daily, vice-president in charge of operations, and J. F. Strough, secretary and treasurer.

The company has been organized to take care of the growing demand for Timken steel among manufacturers of various products, by the production of high grade alloy steels on a quantity basis. Its production facilities consist of the modern furnaces and mills with a capacity of 30,000 tons of steel per month. This capacity is equally divided between electric and open hearth steels. The mill is equipped to supply any section or size of hot rolled bar stock, or seamless tubing, in any quantity desired. Specialized high grade alloy steels can be produced conforming to any analysis specified, with assurance of absolute uniformity.

Stock intended for fabrication into seamless tubing is delivered to a continuous reheating furnace, from which it is delivered directly to the piercing mill. The equipment used for tube fabrication is also laid out to accommodate straight line production. Stock coming from the reheating furnace is delivered directly to the piercing mill, and thence to the reeler. From the reeler it passes to the reducing mill, which is the final process in reducing to the final sections. This equipment will produce tubing in a variety of sizes ranging from 1½ to 6½ inches O. D. From the reducing mill the tubes pass to a hot bed for cooling before further treatment, such as turning, cold drawing, cutting off, or annealing.

San Diego Company Plant Extension Construction Progresses

The construction schedule is being maintained on the new 28,000 kilowatt electric generating unit being installed as an extension to Station B of the San Diego Consolidated Gas and Electric Company and from present indications this project will be completed on the scheduled date, October 1, 1928, according to H. W. Fuller, vice-president in charge of engineering and construction, Byllesby Engineering and Management Corporation.

The power plant building extension is being constructed at the corner of Kettner and Broadway, San Diego, and work was started on the extension in January of this year. The new building will extend 140 feet on Kettner Boulevard and 88 feet on Broadway. Architecture of the building will be of Spanish type.

The addition will be of sufficient proportion to permit the installation of a second unit when needed.

Completion of this unit will increase the generating capacity of Station B from 36,000 kilowatts to 64,000 kilowatts. The extension was made necessary to supply a rapidly increasing load in San Diego brought about by general residential growth and industrial progress in the city and outlying districts.

On account of the increased generating capacity now being installed, most of the old electrical equipment and wiring is being abandoned and replaced with new equipment of larger capacity.

A large cooling water tunnel is being constructed from the Pacific Ocean to the plant, which involves unusual con-

struction difficulties inasmuch as it is an under water job. An unusual feature also was encountered in excavation work for the new building, which is adjacent to the old one. The old building was not built on pile foundation and it was necessary that it be heavily underpinned while the new work was in progress to prevent cave-ins. The new building will rest on concrete piling throughout.

Engineering Research Active at Ohio State

Considerable activity in various fields of engineering research by the staff and attached scientists of the Ohio State University is indicated by the August issue of a recent bulletin of the Engineering Experiment Station of that institution. Projects of special interest to power engineers and manufacturers in the power field include a catalytic study of carbon in connection with the problem of soot removal, experiments with clays and refractories and endurance tests of belting with a new type of belt-testing machine.

The study of the catalytic oxidation of carbon is being conducted by Dr. Jesse Day of the chemistry department. He is investigating the effect of various catalysts in promoting the oxidation of carbon, with a view to the application of the results for solution of the soot-removal problem. Some of these catalysts are often present in coal, for example: silica, common iron oxide, magnesia, lime and alumina. Incidentally, Dr. Day is investigating the value of common salt for soot removal, in view of its frequent proposal for that purpose.

Important investigations are now being conducted by scientists of the Ceramic Experiment Station of the U. S. Bureau of Standards, which is closely associated with the Ohio State University. These include a study of the physical properties of heavy clays and an investigation of the causes of failure of boiler-furnace refractories, the latter being conducted in co-operation with the American Society of Mechanical Engineers.

A new principle of belt testing is used in a testing machine designed by Prof. C. A. Norman. The machine is now being used in endurance tests by Norman and Moffat at the mechanical-engineering laboratory.

The principle is simply that of testing two belts simultaneously by having them pull against each other. That paradoxical result is achieved by running the belts parallel over two double pulleys with grooves of unequal diameters so that each belt runs on the larger diameter of one pulley and on the smaller diameter of the other. The belt on the larger diameter of the first pulley (the one which is turned by a motor) has a tendency to turn the second pulley. On the second pulley the other belt is on the larger diameter, and, consequently, tends to turn the first pulley. One belt is thus slack on the upper side, the other on the lower side. The differential in pulley diameters can be varied to suit the operator but must be kept below an amount which will cause overheating of the belt.

At 1,500 r.p.m. the rapid change from slackness to tension causes a strain on the belt which is comparable to heavy service. Such endurance tests can be made by heavy overloads, but that requires the expenditure of a vast amount of power. For the device described a small motor is ample, as all the power required is that used up in friction losses and internal strains in the belt. The whole machine is not over six feet long and can be set in any convenient corner.

Coming Conventions

American Institute of Electrical Engineers, annual winter convention, New York City, Jan. 28-Feb. 1; annual summer convention, Swampscott, Mass., June 24-28; F. L. Hutchinson, secretary, 33 West 39th St., New York City.

American Refractories Institute, fall meeting, Pittsburgh, Pa., Oct. 24, D. A. Texter, secretary, 2202 Oliver Building, Pittsburgh, Pa.

American Society of Mechanical Engineers, Boston regional meeting, Oct. 1-3; Calvin Rice, secretary, 29 West 39th St., New York City.

American Welding Society, fall meeting at Philadelphia, Pa., Oct. 8-12; M. M. Kelly, secretary, 29 West 39th St., New York City.

Midwest Power Conference and Exhibition, at Chicago, Feb. 12-16; G. E. Pfisterer, secretary, 53 West Jackson Blvd., Chicago.

National Association Practical Refrigerating Engineers, annual convention at Louisville, Kentucky, Nov. 20-23; E. H. Fox, secretary, 5707 West Lake St., Chicago, Ill.

National Exposition of Power and Mechanical Engineering will be held at the Grand Central Palace, New York City, Dec. 3-8. Address inquiries to the International Exposition Company, Grand Central Palace, New York City.

Stoker Manufacturers Association, fall meeting at Greenbrier Hotel, White Sulphur Springs, W. Va., Oct. 22-24.

Second Bituminous Coal Conference will be held at Pittsburgh, Nov. 19-22.

World Power Fuel Conference at the Imperial Institute, London, Sept. 24 to Oct. 6.

Shipping Board Plans Series of Pulverized Fuel Tests

In conjunction with the Shipping Board's program for trying out pulverized fuel, tests on various types of pulverizers and burners have been in progress for the past two years—the installation on the Mercer being identified with one of these sets of tests.

A new set of tests are being undertaken on a unique combined pulverizer and burner unit, one of which is attached to each of the three furnaces of a marine-type boiler. This arrangement was devised in order to eliminate the trouble experienced in distribution when one pulverizer served three furnaces. Each unit has a rated capacity to pulverize 750 lb. of coal an hour, is very compact and is driven by a high-speed, a.c. motor. The pulverizer is of the hammer mill type.

Power expects later to publish a detailed description of the pulverizer and burner unit together with the results of the tests now started.

Novel Ventilating System Used in Large Generator

One of the latest type turbo-generator units yet developed will be installed by the Kansas City Power and Light Company in their Northeast Station in Kansas City. The unit was purchased recently from the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

The unit consists of a 12,500-kva., 3,600-r.p.m., 2-pole, 60-cycle generator coupled to a 10,000-kw., 1,200-lb. steam turbine. The generator equals in size any other of the same speed in this country, and its construction is unique in that double-entrance fans of special design are used on the rotor. In this installation it was impossible to obtain the required ventilation by the type of fan ordinarily used. Higher efficiency is obtained because of the lower fan losses of the new type.

The turbine is one of the first 1,200-lb., 10,000-kw. units ever built, and is the first of its kind produced by Westinghouse. The exhaust steam from this turbine, at about 385 lb. pressure, will be used to drive other units in the Northeast Station.

Diesel Engine Power Plant for Fiji Islanders

Word has reached the U. S. Commerce Department that the municipal council at Suva, Fiji Islands, has decided to purchase a new generating plant for its power house. Although due to a preferential duty only a British plant will be considered. The increased power production is expected to increase materially the demand for American appliances that are obtained principally from San Francisco jobbers.

The electrical engineer for the council has recommended the purchase of two Diesel plants of 1,250-kw. capacity. The present plant consists of two Hornsby suction gas engines and Silvertown generators of 75 kw. each. This plant has reached the limit of its usefulness due to heavy maintenance and repairs. Furthermore wood supplies for the production of suction gas are becoming unreliable.

Conference on Standards for Malleable Iron Unions to be Held

The Bureau of Standards, U. S. Department of Commerce, has announced that a general conference of Manufacturers, distributors and users will be held on September 24 under the auspices of the Commercial Standards Unit in the Commerce Building, Washington, D. C., for the purpose of considering a proposed commercial standard for 250 lb. malleable iron or steel screwed union. This conference, which has been arranged by I. J. Fairchild, Commercial Standards Unit, at the request of the industry, will discuss the proposed standard in open meeting.

Combustion Engineering Buys Hedges-Walsh-Weidner Company

International Combustion Engineering Corporation has completed negotiations for the purchase of the Hedges-Walsh-Weidner Company of Chattanooga, Tenn., a recent combination of the Casey-Hedges Company and the Walsh & Weidner Boiler Company, two of the oldest boiler manufacturing companies in the United States.

With this new company, International Combustion augments its present extensive manufacturing facilities with two modern boiler plants, one of which is an outstanding factor in the sectional header boiler field, and the other has facilities for the manufacture of larger drums than most other plants in the United States.

This acquisition is in keeping with International Combustion's policy of expansion along sound economic lines by acquiring going units of high standing, whose business fits in with the company's policy of completely covering the fuel burning and steam-generating field.

Acquisition of the Hedges-Walsh-Weidner plants is of particular importance to Combustion at this time as it provides them with manufacturing facilities of sufficient size to handle the steam generating units upon which Combustion is specializing — such as those recently installed by the New York Steam Corporation at its Kip's Bay plant, and those to be installed by the New York Edison Company at its Fourteenth Street plant. Boilers of the latter, delivering 1,000,000 pounds of steam an hour, will be the largest in the world.

The acquisition will function in all phases of its activity through Combustion Engineering Corporation, the American operating subsidiary of International Combustion Engineering Corporation.

PERSONALS

FRANK D. COMERFORD, President of New England Power Association, has been elected a director of International Paper Company. International Paper Company owns 45 per cent of the common stock of New England Power Association, and it is expected that International Paper and Power Company—the new company which is to be formed to take over the properties of International Paper Company—will hold a very large majority of the common stock of the association.

CHARLES J. ARTHUR, until recently sales engineer for the A. R. Amos, Jr. Company of Philadelphia, has joined the sales staff of the Wagner Electric Corporation at its Philadelphia office.

T. H. WALKER, for the last two years superintendent of production with the Narragansett Electric Company, Providence, R. I., has resigned, to accept a similar position with the United Engineers and Constructors of Philadelphia.

E. A. EDWARDS, who has been connected with Schumaker-Santry Company, Boston, for eleven years, has associated himself with the Boston District Office of the Warren Steam Pump Company, Inc., at 101 Milk Street.

BUSINESS NOTES

THE ERIE CITY IRON WORKS, Erie, Pa., has appointed the Alan G. Gary & Co., as its sales representative in St. Paul, Minn.

BOTFIELD REFRACTORIES COMPANY, Philadelphia, Pa., announces the appointment of W. E. Tierney as its representative in the South and Southwest with headquarters at New Orleans, La.

THE OILINE REFINING COMPANY, of America, 183 Ogden St., Newark, N. J., announces that James M. Potts is now connected with the company in the capacity as vice-president.

TRADE CATALOGS

OIL BURNING SYSTEM—The Anthony Nebulyte oil burning system is described and typical applications shown in a 16-page bulletin issued by the Anthony Company, 138 West Ave., Long Island City, N. Y. The burner is of the mechanical atomizing type and is designed for use with forced- or induced-draft systems.

CENTRIFUGAL PUMPS—A new line of centrifugal pumps designed to give improved efficiencies are described in Bulletin No. 38, Edition No. 4, just issued by the American Steam Pump Company, Battle Creek, Mich. The various parts of the pump are illustrated and described in detail, together with views of the various types and forms of drive.

SPEED CHANGERS — The Stephens-Adamson Manufacturing Company, Aurora, Ill., has issued a four-page folder containing detailed description and dimension of all sizes of J. F. S. variable speed transmissions, including a new size for transmitting fractional horsepowers suitable for operating automatic speed control mechanisms, etc.

INDUSTRIAL LUBRICATION—The Acheson Graphite Corporation, Niagara Falls, N. Y., has issued a new catalog entitled Industrial Lubrication, in which is described the sixty different types and consistencies of "Gredag" lubricants. Definite recommendations for their application to industrial and automotive machinery are also included. The catalog also contains technical and engineering data.

SUPERHEATER—In a new catalog No. 304 just issued by the Foster-Wheeler Corporation, 165 Broadway, the applications of the Foster superheater to many types of boilers, including longitudinal-drum, cross-drum, bent-tube and return-tubular, are clearly illustrated and described. The types of superheaters described include convection, radiant-heat, combination, separately fired, waste-heat and portable. The various types of boilers illustrated, to which these have been fitted, include many modifications of design such as vertical and horizontal baffling, waste heat and single-pass. The details of construction of the superheater are clearly shown through cross-sectional and cut-away views. Five pages of the catalog are devoted to a table of steam properties, extending up to 1,500 lb. abs. pressure, and 300 deg. superheat.

MARINE GENERATING SETS—Small vertical engine-driven generating sets, especially designed for use on shipboard and for emergency lighting are described in bulletin G.E.A. 781A, issued by the General Electric Company, Schenectady, N. Y. The units are built in sizes from 5 to 30 kw., with the generator made in two-wire and three-wire types, with either shunt or compound field windings.

FUEL PRICES

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard	New York	$2.30@$2.50
Kanawha	Columbus	1.25@ 1.60
Smokeless	Cincinnati	1.75@ 2.25
Smokeless	Chicago	1.75@ 2.25
S. E. Kentucky	Chicago	1.50@ 1.75
Steam	Pittsburgh	1.40@ 1.90
Gas Slack	Pittsburgh	1.15@ 1.25
Big Seam	Birmingham	1.25@ 1.50
Anthracite (Gross Tons)		
Buckwheat	New York	$3.00
Barley	New York	1.35@ 1.75

FUEL OIL

New York—Sept. 13, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4¾c. per gal.; 36@40 deg., furnace, tank-car lots, 7c. per gal.

St. Louis — Sept. 5, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.346 per bbl. or 42 gal.; 26@28 deg., $1.396 per bbl.; 28@30 deg., $1.446 per bbl.; 30@32 deg., $1.50 per bbl.; 32@36 deg., gas oil, 4.151c. per gal.; 38@40 deg., 4.98c. per gal.

Pittsburgh—Aug. 20, f.o.b. local refinery, 30@34 deg., fuel oil, 5½c. per gal.; 36@40 deg., 5¾c. per gal.

Philadelphia—Sept. 6, 26@30 deg., $1.94@$2.01 per bbl. or 42 gal.; 13@19 deg., $0.995@$1.065 per bbl.; 22 plus, $1.52@$1.57 per bbl.; 27@30 deg., $2.14@$2.21 per bbl.

Cincinnati—Sept. 10, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5½c. per gal.; 30@32 deg., 5.95c. per gal.

Chicago—Sept. 1, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 57½@ 60c. per bbl.; 26@30 deg., 75c. per bbl.; 30@32 deg., 90c. per bbl.

Boston—Sept. 11, tank-car lots, f.o.b. 12@14 deg. Baumé, 4.4c. per gal.; 28@ 32 deg., 5.6c. per gal.

Dallas—Sept. 8, f.o.b. local refinery, 26@30 deg., $1.15 per bbl. or 42 gallons.

New Plant Construction

COMPILED BY THE MCGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif Kaweah — Southern California Edison Co., 306 West 3rd St., Los Angeles, had plans prepared for the construction of a power house 3,800 hp. on Kaweah River here to replace old power plants of 1,900 hp. each. Estimated cost $160,000. Private plans.

Conn., New Haven—United Illuminating Co., Temple St., awarded contract for a 30 x 80 ft. power sub-station on Goffee St. to B. N. Blatchley Co., 902 Chapel St. Estimated cost including equipment $40,000.

Fla., Boca Baton—City awarded contract for the construction of a pumping station to C. R. Donathan, Miami. Estimated cost $48,000.

Ind., Kendallville — Common Council, W. A. De Vault, Clk., will receive bids until Sept. 18, for extensions and improvements to municipal electric light and water plants including turbine house, etc. Froehlich & Emery Engineering Co., 412 Second National Bank Bldg., are engineers.

Mass., Andover—Phillips Andover Academy, J. H. Buttimer, is receiving bids for a 80 x 85 ft. power house on Academy grounds. Estimated cost $40,000. R. D. Kimball Co., 6 Beacon St., Boston, is engineer.

Minn., Minneapolis—St. Barnabas Hospital, C. E. Purdy, Secy., 1123 Metropolitan Life Bldg., will soon receive bids for the construction of a 4 story hospital building at 7th St. between 9th and 10th Aves. and power plant, at 6th St. between 9th and 10th Aves. S. Estimated total cost $600,000.

Mo., Clayton—St. Louis County, County Court, will soon receive bids for first unit of hospital including nurses' home, power plant, etc. Estimated cost $300,000. Total cost $1,000,000.

Neb., Bloomfield—City, F. Hughes, Clk, will soon award contract for the construction of a sewage disposal plant including pump house, etc. Estimated cost $21,480.

N. Y., Bethlehem—Bd. of Sewer Comrs., J. A. Burkart, Secy., 22 South Pearl St., Albany, will receive bids until Sept. 25 for a sewage system and sewage disposal works including pumping station, etc. for Delmar-Elsmere Sewer Dist. here. R. C. Wheeler, 36 State St., Albany, is engineer.

N. Y., New York—Bd. of Health, 505 Pearl St., will receive bids until Sept. 24 for additions and alterations to transformer building, also light and power system at Riverside Hospital, North Brother Island.

N. Y., New York—New York Edison Co., 130 East 15th St., awarded contract for the construction of addition to power plant at 701 East 14th St. to Kennwell Construction Co., 45 East 17th St. Estimated cost $1,850,000.

O., Painesville—City, R. M. Evans, City Mgr., awarded contract for the construction of a power house for municipal light plant, to The Mitzel Co., B. F. Keith Bldg., Cleveland. Estimated cost $40,000.

Okla., Duncan—City, plans the construction of a 50 ton raw water ice plant. Estimated cost $100,000. H. Sullivan, Lone Wolf, is engineer.

Okla., Henryetta—City awarded contract for the construction of a power house and purification plant to George M. Brown & Co., McAlister, Okla. Estimated cost $44,748.

Okla., Tulsa—City had preliminary plans prepared for the construction of a hydro-electric plant on Grand River near Spavinaw. Estimated cost $500,000. B. M. Hart, is engineer.

Texas—Central Power & Light Co., Frost Bldg., San Antonio, is having plans prepared for the construction of five power dams, 4, 5, 6, 7 and 8, total capacity 15,000 hp. on Guadalupe River between New Braunfels and Gonzales. Estimated cost $75,000 each. Private plans.

Tex., Houston — City Council, W. A. Moore, Secy., has been authorized to advertise for bids for the construction of a power house for Jefferson Davis Hospital.

Tex., Pharr — Hidalgo County Water Improvement Dist. 2. A. Van Dresar, San Juan, Mgr., will build and purchase equipment for irrigation project including the installation of pumping units, etc. in Pharr, San Juan and Alamo districts. Estimated cost $3,000,000. P. S. Devine, Edinburg, is company engineer.

Tex., San Antonio—Express Publishing Co., Navarro and Crockett Sts., awarded general contract for the construction of a publishing plant including cooling system to L. T. Wright & Co., 910 Builders Exchange Bldg. Estimated cost $646,400.

Va., Quantico—Bureau of Yards & Docks, Navy Dept., Washington, D. C., will soon award contract for the construction of a group of apartment buildings, power house, etc. at Marine Barracks here.

W. Va., Charleston — New Kanawha Power Co., Glen Ferris, subsidiary of Union Carbide & Carbon Co., 30 East 42nd St., New York, has made application for authority to build two dams, two tunnels and two hydro-electric plants to develop 50,000 hp. near Hawk's Nest and Gauley Junction.

Ont., Oshawa—Oshawa Street Railway, H. W. Cooper, Mgr., Simcoe St., awarded contract for the construction of a car barn, substation, etc. to Bath & McLellan, 17 Young St. Estimated cost $150,000.

Ont., Walkerton—W. B. Foshay Co., 9th St. and Second Ave., Minneapolis, Minn., plans to improve and increase capacity of present power plants, also extend power lines into rural sections, here. Estimated cost $150,000. W. A. Emerson, Walkerton, Ont., is engineer.

Brazil, Bahia — Electric Bond & Share Co., 2 Rector St., New York, N. Y., subsidiaries American Foreign Power Co. and Emprezas Electricas Brasileiras, Bahia, plans the installation of a new automatic telephone system throughout the city, also the construction of a hydro-electric plant on the Paraguassu River and two traffic elevators to link together two transportation systems to Companhia Linha, Bahia.

Equipment Wanted

Boilers, Stokers, Etc.—Dept. of Mental Diseases, Waltham, Mass., will receive bids until Sept. 25, for boilers, stokers, etc. for boiler house at Metropolitan State Hospital.

Generator—Bureau of Yards & Docks, Navy Dept., Washington, D. C., oil engine generator and switchboard at Naval Station, Guantanamo Bay, Cuba.

Motor Generator Set — Dept. of Public Works, S. E. O'Brien, Secy., Ottawa, Ont., will receive bids until Sept. 21, for the installation of a new motor generator set for ship lighting at Graving Dock, Esquimalt, Nanaimo Dist., B. C.

Oil Burner—Blytheville Steam Laundry, Blytheville, Ark., is in the market for an oil burner for 40 hp. boiler.

Pump — City of Oceanside, Calif., plans to purchase pump, etc. for proposed waterworks improvements. Estimated cost $50,000.

Pump—City of Apache, Okla., is in the market for a 60 g.p.m. deep well pump.

Pump—Executive Dept., Division of State Police, 190 State St., Albany, N. Y., will receive bids until Oct. 2, for pump, etc. for sewage disposal system at State Police Barracks, Westchester County, N. Y.

Pump and Motor — City of Archer City, Tex., 500 g.p.m. pump and motor, etc. for proposed waterworks improvements. Estimated cost $40,000.

Pump and Motor—City of Maud, Okla. is in the market for one 50 and one 75 g.p.m. deep well pump and 10 hp. motors.

Refrigeration Equipment—Bd. of Health, 505 Pearl St., New York, N. Y., will receive bids until Sept. 28 for the installation of refrigeration equipment for service building at Willard Parker Hospital, Ft. East 16th St.

Transformers—City of Cleveland, O., will receive bids until Sept. 21 for five 50 kv. single ph. subway type distribution transformers, etc.

Industrial Projects

Calif., Culver City — TILE ROOFING FACTORY—California Spanish Tile Roofing Co., is having plans prepared for a 1 story, 65 x 156 ft. factory on Elenda St. A. B. Sturges, 4354 West 3rd St., Los Angeles, is architect.

Calif., San Leandro — ASSEMBLY PLANT — Chrysler Co., Highland Park, Mich., plans the construction of an assembly plant at Durant Ave. and East 14th St., here. Estimated cost $1,000,000.

Calif., San Rafael—CREAMERY—Marin County Milk Co., 825 4th St., awarded contract for a 2 story, 60 x 130 ft. creamery to F. H. Allen Inc., 232 Main St., San Anselmo. Estimated cost $40,000.

Colo., Denver — WAREHOUSE, SERVICE BUILDING, etc. — Public Service Co. of Colorado, C. N. Stannard, V. Pres. and Gen. Mgr., 15th and Champa Sts., awarded contract for a 2 story warehouse and service building at Lipan and Mariposa Sts. and West Third and Fourth Aves. to F. H. Cowell, Central Savings Bank Bldg., also for garage on West Third Ave. between Lipan and Mariposa Sts. to Mead & Mount Construction Co., First National Bank Bldg. Estimated cost $530,000.

Ill., Chicago — PIE FACTORY — Pellar Bros., 3659 West Harrison St., awarded contract for a 2 story, 200 x 250 ft. pie factory at 26th St. and California Ave. to Williams Adams Co., 209 South La Salle St. Estimated cost $600,000.

Ind., South Bend — ENGINEERING BUILDING—Studebaker Corp., awarded contract for a 2 story, 240 x 432 ft. engineering building at Franklin and Sample Sts. to H. G. Christman, 306 South Notre Dame St. Estimated cost $100,000.

Ky., Louisville—AUTOMOBILE BODY FACTORY—Mengel Body Co., Fourth and G Sts., awarded contract for a 1 story, 306 x 441 ft. factory to Struck Construction Co., 149 North Clay St. Estimated cost $1,000,000.

Md., Baltimore—CORK and SEAL FACTORY—Crown Cork & Seal Co., is having plans prepared for a 1 and 2 story, 150 x 600 ft. factory. L. R. White, Hearst Tower, is architect.

Mo., St. Louis — PLUMBING SUPPLY FACTORY — N. O. Nelson Mfg. Co., 928 Chestnut St., will soon receive bids for a 2 story factory, warehouse, etc. for the manufacture of plumbing supplies at Duncan and Boyle Aves. Estimated cost $300,000. P. J. Bradshaw, 718 Locust St., is architect.

N. Y., Ridgewood—BREWERY—City Brewing Corp., Cypress Ave. and Weirfield St., Brooklyn, plans the construction of a 5 story, 42 x 42 ft. brewery including refrigeration system, here. Estimated cost $30,000.

O., Cincinnati—COPPER FACTORY—Tennessee Copper Corp., Skillman Rd., awarded contract for a 1 story, 208 x 420 ft. factory to Ferro Construction Co., Elm St. Estimated cost $500,000.

O., Dayton—METAL SPINNING FACTORY—The Variety Mfg. Co., 2901 West Third St., awarded contract for a 1 story factory on Minerva St. to Hillsmith & Co., Winters Bank Bldg. Estimated cost $55,000.

Okla., Sand Springs—STEEL MILL—Tulsa Rolling Steel Mill., c/o J. H. McAlarney, 215 Mid-Continent Bldg., Tulsa, is having plans prepared for a 1 story, 135 x 432 ft. steel rolling mill here. Estimated cost $200,000. L. G. Burton, Mid-Continent Bldg., Tulsa, is architect and engineer. Work will be done by day labor.

Tex., Brady—POWDERED MILK PLANT—Stock Co., c/o W. D. Crothers, Chn., plans the construction of a powdered milk plant, 120,000 bbl. daily capacity. Estimated cost $275,000. Machinery and equipment will be required.

Wis., Madison—PAINT and GLASS FACTORY—Mautz, Paint & Glass Co., will soon award contract for a 3 story, 60 x 150 ft. factory. Estimated cost $80,000. Law, Law & Potter, are architects.